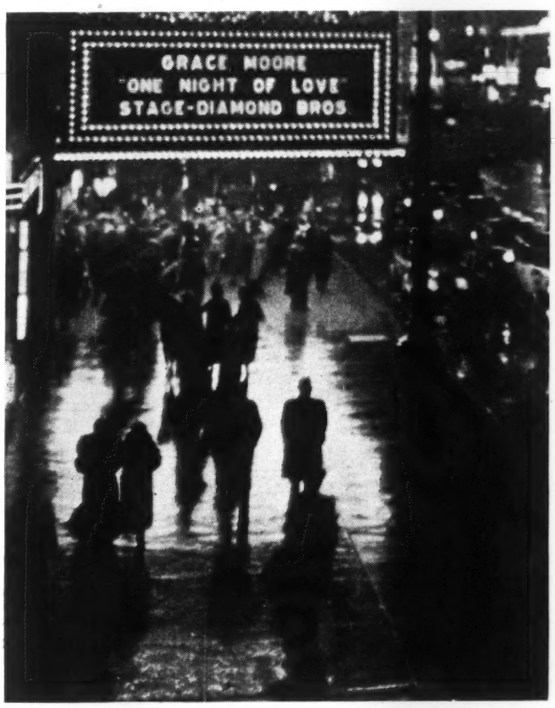
Heating · Piping and Air Conditioning

December, 1934 *Vol. 6, No. 12*

Consulting Engineer Surveys Theater Heating and Air Conditioning —*finds need for* MODERNIZATION



By **D. D. Kimball***

This survey of the heating, ventilation, and air conditioning of seventy-six motion picture theaters—completed just last month—was made because of the feeling that ordinary inspections had become routine, conditions as they developed being accepted as natural or inevitable. Exact knowledge of the state of the properties surveyed was desired for several reasons, among them being a contemplated rebuilding and new building program.

The survey clearly justified itself, bringing to light many situations needing correction, numerous opportunities for necessary modernization. This report of the survey is one of the most informative articles ever published on this subject.

BETWEEN May 1 and November 1, 1934, the writer inspected the heating, ventilating and air conditioning installations in 76 motion picture theaters.[1] A general resumé of the equipment found in these theaters together with some conclusions resulting from this work should be of general interest. Inasmuch as these theaters were built by a number of different owners and over a long period of years they may be assumed to represent a fairly representative cross-section of the character of theater equipment generally as installed up to the present time, together with an indication of the changing practices in the theater equipment installations.

These theaters ranged from six to eighty-four years old, with mechanical equipment varying from the most antiquated to the most modern, but be it said that in practically no instance was there found an installation as carefully and completely designed and installed as the present-day knowledge of air conditioning engineers really makes possible. Not a small proportion of the ventilating and cooling installations evidenced amateurish efforts and some of them were found to represent little more than the results of remarkable efforts on the part of equipment salesmen.

*Consulting Engineer, New York City. Member of Board of Consulting and Contributing Editors.

[1]In the territory from Boston to Chicago, south to Washington.

CLASSIFICATION OF EQUIPMENT FOUND

A general classification of the equipment found is as follows:

BOILER PLANTS:
- Cast iron sectional....25[2]
- Fire box....25[3]
- Horizontal return tubular....12
- Water tube....5
- Purchased steam....10

FUEL:
- Anthracite coal....44
- Bituminous coal....12
- Oil....10

PIPING SYSTEM:
- One pipe system....16
- Two pipe gravity steam....28
- Vacuum steam systems....32

RADIATION:
- Exposed....27
- Concealed....49

Cast iron radiation only is found, except for pipe coils on the stage in the older houses.

PIPE COVERINGS:
- None, or none outside of boiler room....11
- On supply mains only....45
- On both supply and return mains....20

Practically all pipe covering material was asbestos air cell. Only a small amount of magnesia covering was found.

DIAGRAMS:
- Piping diagrams available....5
- Valve charts and tags provided....15
- Ventilation plans available....1
- No record at the plant....55

TEMPERATURE AND HUMIDITY REGULATION:

Temperature Regulation
- On direct radiation....Manual 69....Automatic....7
- On air heaters....Manual 15....Automatic....37

Humidity regulation, where humidification is provided, is always automatic.
- Hot water temperature regulation..Manual.42.Automatic.17
- With gas heaters or no hot water supply....17

Ventilation[4]
- (a) None....7
- (b) Supply only....2
- (c) Exhaust only....4
- (d) Supply or exhaust (by reversing rotation of fans).8
- (e) Floor supply with ceiling exhaust....9
- (f) Ceiling supply with floor exhaust (or return)....35
- (g) Nondescript....11

DISTRIBUTION:
- Very few supply inlets....26
- Generally distributed supply inlets....39
- Exhaust or return outlets:
  - (a) Mostly in front....8
  - (b) Mostly in rear....24
  - (c) Mostly in sides....5
  - (d) Generally distributed....26

ACCESSORY SPACES:
- Toilets:
  - (a) Mechanical exhaust....36
  - (b) Window ventilation....40
- Lobbies; air supplied....21
- Foyers; air supplied....23
- Projection Rooms:
  - (a) Air supplied....2
  - (b) Fan exhaust....76

COOLING INSTALLATIONS:
- Good....24
- Fair....11
- Makeshift....2
- None....39

DEHUMIDIFIERS:
- With direct expansion coils....16
- Without....21

AIR FILTERS:

Air filtered in 2 theaters only.

AIR HEATERS:
- Pipe coils....4[5]
- Cast iron....23
- Aerofin....27

DUCT SYSTEMS:
- Ample....31
- Deficient or none....45
- Well installed....32
- Poorly installed or none....44

REFRIGERATING MACHINERY:
- CO_2 horizontal....13
- CO_2 vertical....4
- Centrifugal....18
- One unit installed....23
- Two units installed....12
- Ice cooling....None

COOLING TOWERS:

In 5 theaters only.

WELLS:

In one case only.

[2]Mostly in older buildings.
[3]One plant with two kinds.
[4]a, b, c, d, e, and g represent the older theaters.
[5]In very old houses only.

Discussion of Results of Survey

In the following paragraphs, the results of this survey are discussed in detail under specific headings, and the author's recommendations—based upon his study—are given:

Service and Maintenance: This was almost uniformily high grade and only in a few of the older and leased houses was there found evidences of neglect.

Periods of Operation: In no case was there found in effect a set schedule as to periods of time or outside weather conditions governing the operation of the plant. Where a table was provided for the operation of the cooling plant in accordance with certain outdoor conditions little heed was paid thereto. Most often the judgment of the operating engineer is found to be the determining factor, but in some instances the cooling plant is operated only upon the instruction of the house manager.

Maintenance of Records: No scientific effort is made to determine the economy of operation of the boiler plant, even in the larger installations. While the fuel purchased and on hand may be recorded, not one instance of weighing or measuring the fuel as used, or of determining the output of steam therefrom, was found.

Temperature and humidities are regularly recorded in the houses having cooling plants. Two faults are found in this work. First, the readings are made by means of sling psychrometers which must be used in a clear space, such as the aisles, somewhat remote from the occupied areas, and thus the readings often do not give a correct picture of the conditions affecting the patrons; second, in some cases the records are entered more with an eye

to the ideal than to the actual readings. A typical example of the latter is a large house with balcony and gallery where the record showed not a degree of difference in dry bulb (or wet bulb) temperature readings at any two points in the theater while crowded with patrons.

A better and quicker method of taking dry and wet bulb temperature readings, one indicating the effect of air movement also (comfort zone indication) by means of a light and simple instrument which may be carried into the densely occupied sections of the theater and be quickly read is desirable.

Where instruments were provided for reading temperatures and humidities at remote points such instruments were invariably inoperative, although the operating engineers expressed themselves as desiring such methods. This would save the twice-daily patrol of the house which necessitates leaving the machinery rooms without attendance.

Use of Equipment: It is interesting to note that most generally all available ventilating equipment is used during the occupancy of the theater; also that the conditions in those theaters without ventilation, or with inadequate ventilation, is often far from inviting. A certain theater has been known to be referred to as "the stink house."

Wastes: There is surprising little waste found in the operation of these theater plants. In the larger buildings it would doubtless pay well to provide the means of determining the efficiency of operation of the boilers by weighing or measuring the fuel as fired and metering the steam or condensation.

In occasional cases the lack of care of equipment, radiator and drip traps not cleaned, rusting piping, dirty fans, pumps and motors, etc., represent losses through unnecessarily rapid deterioration and perhaps some excessive power consumption.

Competitive Plans: The most limiting and damaging effect on theater cooling installations as found is that brought about through the employment by the architect or owner of plans or engineering services where the selection of the contractor, or the purchase of the equipment, has been based upon purely competitive plans and bids. The result has been that very few installations are of a character even approaching the ideal, some of them fail to approach even a practical standard, and some are failures. Very frequently the points of "trimming" are easily distinguished, such as insufficient capacity, abbreviated duct work, limited distribution, etc.

Frequent lack of harmony in design and purpose between the cooling system provided for the theater proper and the ventilation available for other spaces, and with the heating system, is noticed in the installations thus purchased.

Without undertaking to claim that the consulting engineer is better qualified to design air conditioning systems (perhaps some of them are not) he at least works without competitive limitations, without the "trimming" training, and generally without unnecessary extravagance. If worth employing, he works toward that ideal which is practical both in efficiency and cost. No owner has the right to assume that he can "trim" the cost while retaining the full efficiency of a ventilating and cooling installation.

Direct Radiation: The use of direct radiation in the theater proper (orchestra, balcony, etc.) appears to grow progressively less with the passing of time. Inasmuch as where such direct radiation exists in buildings equipped with an adequate ventilating system it is rarely used (in some cases never), the weight of evidence seems to be against installing direct radiation in the theater proper.

It is now the general practice to conceal in grilled recesses all direct radiation in important rooms. More attention should be given however to the provision of means of access to all valves and traps in the enclosures and for the thorough cleaning of the recess.

Direct radiation is required on the stage, in dressing rooms, toilets, offices, etc. In the lobbies direct radiation must be used where the more desirable separate fan supply of conditioned air is not provided. The stage radiation should be ample, as otherwise the front seating section of the orchestra becomes chilled.

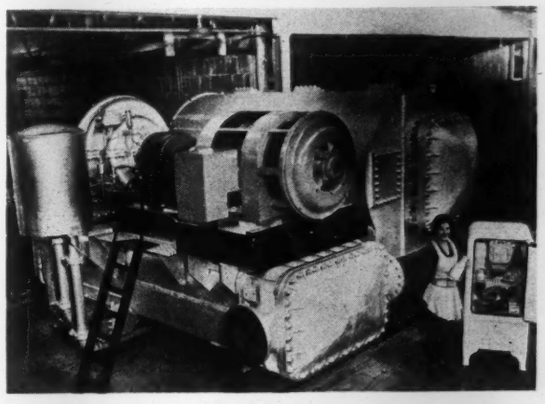
Boilers: In general the fire box type of boiler seems best to meet the needs of the theater except in the case of the very small theaters where cast iron sectional boilers do nicely.

Heating System: The vacuum steam heating system appears to be the most suitable for theater work, even as it is the most efficient. Separate steam supply lines should be run from a main steam header in the boiler room to the various elements of the theater such as stage, dressing rooms, air heaters, lobbies, and stores or offices (if such exist). Main control valves should be conveniently located in the boiler room. In some cases it was found that no control valves were provided; in other cases these valves are scattered in the basement

---

LARGEST REFRIGERATING MACHINE

. . . . ever built, assembled in the shops prior to shipment to the South African gold fields, where with three similar units it will supply refrigeration for air conditioning the Robinson Deep gold mine, which has penetrated 8,380 ft below the earth's surface. . . . This unit weighs 100,000 lb, holds more than a ton of refrigerant, has a mile of copper cooling coils, is 10 ft high, 18 ft long, 16 ft wide, is driven by a 750 hp motor. It will produce 2,500 gpm of cooled water. The machine is equal in capacity to more than 12,000 refrigerators like the one shown. (Photo, Carrier Engrg. Corp.)



Production Methods *in* Pipe Welding *for* Plant Construction

By G. E. Deatherage*
and J. B. Latterner†

IN industrial plants where fluids and gases are processed at high temperatures and pressures, the piping must be designed and constructed with the same care as the pressure vessels which the piping connects. Thus when piping is fabricated right on the job during construction of a plant, it becomes one of the most important jobs the field forces have to do. If it should be a chemical plant containing a maze of piping, interconnecting practically every piece of equipment in the place, fabrication and erection of the piping becomes by far the most important field operation, worth the unceasing attention of the construction superintendent.

On a well organized construction job, the erection of lines is pushed aggressively because of other work waiting on the piping. A delay in the installation of some one line might interfere with the completion of a half dozen related jobs. The organization must be such that pipe materials are received, fabricated, and the piping erected in accordance with a general construction schedule without jamming any one department with more material or work than can be handled, and without having an overmanned labor crew.

In the construction of various units of a large chemical plant in West Virginia, we early recognized the important part that the piping organization played in the rapid and economical completion of the job. Over a period of years detailed and efficient procedures for pipe fabrication and installation have evolved from our interest in this phase of the work and our constant desire to improve on past practice. In so far as possible it has been our aim to bring together into a single systematic organization the many miscellaneous activities found on a construction job—to put field work on the same basis common to most all shop production layouts.

In our piping work all joints that possibly can be are oxy-acetylene welded, hence the piping organization is built entirely around the welding process. Welding has made practicable "made to measure" fabrication and erection of a complete piping job; in the eyes of the construction superintendent this is probably the most important single contribution of welding to construction practices because it simplifies putting the field work on a systematic basis and places piping installation in the same class with structural steel erection, where members are fabricated to exact dimensions in the shop and are fitted together in orderly manner in the field in coordination with other portions of the construction program.

The plan of operation built around the "made to measure" idea is the logical outcome of experience gained on a number of jobs and the recognition of certain basic facts. Foremost among these is the facility with which a section of a line can be fabricated to exact dimensions by welding—no matter what size the pipe—with assurance that the section will fit into its proper place in the line when delivered on the job.

A second factor recognized in applying production methods to piping installation was that the activities of the workman should be confined solely to actual fabrica-

[*Continued on page 505*]

*General Superintendent of Construction, Whiting, Ind., and †Chief, Planning Dept., Construction Division, Carbide & Carbon Chemicals Corp., So. Charleston, W. Va.

From a paper read at the 35th annual convention of the *International Acetylene Association*, Pittsburgh, Pa., November, 1934.

Theater Survey—

and in tunnels or trenches, sometimes quite inaccessible.

Diagrams: Every operating engineer should be provided with a complete apparatus, duct and piping layout, together with a main valving schedule, the valves to be provided with numbered tags. Occasionally the valve schedules and tags are found in the theater but practically no apparatus, duct or piping diagrams are available unless it be some "typical" diagram which means little as applied to the particular installation. In case of an emergency the engineer is left to hunt for his pipe lines or control valves. These are frequently changed and such emergencies may arise before an engineer becomes familiar with his system. Occasionally an engineer shows little interest in those portions of the installation outside of the boiler and machine rooms.

Temperature Control: The thermostatic control of direct radiation had been allowed to fall into dis-use in those theaters studied in which it had been installed; it hardly seems worthwhile to provide equipment which will neither be used nor maintained. Where the system of thermostatic regulation as applied to the ventilating system was elaborate it, too, had been neglected and fallen into dis-use. Only the simplest forms of automatic temperature (and humidity) control, applied to the main heaters and dampers are regularly used and maintained .

Such systems should be simple and be easily understood by the operating engineer. A complete diagram and detailed explanation of this system and its operation, with a diagram of the construction of the thermostats, should be provided at the spot where the instruments are placed. Inasmuch as "servicing costs" as charged by the manufacturer do not appear to be cheerfully accepted by the owner it should be made possible for the operating engineer to keep this equipment operative, else the use of automatic devices will shortly fall into disfavor and be discontinued.

Hot water storage tank temperature regulators are desirable but they appear to have been installed only in theaters of the better class.

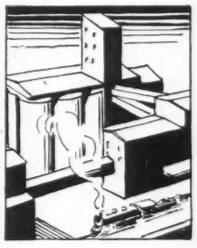
[A second article based on this survey will discuss in a detailed and practical manner the air conditioning and ventilation of theaters.—EDITOR.]

When Does Building Insulation Pay?

Where heat is required to maintain a given temperature in winter air conditioning, or refrigeration is required for the same purpose in summer air conditioning, building insulation permits maintaining the desired temperature more economically

By **Paul D. Close***

AIR conditioning involves—among other things—the simultaneous control of temperature, humidity and air motion within an enclosure. So far as the economics of insulation is concerned, the only factor that need be taken into consideration is the temperature, or more correctly, the temperature head or dry bulb temperature difference inside and outside of the enclosure. Although wet bulb temperatures may have an important bearing on the heating and/or cooling load, the effect on the thickness of insulation to be used under certain circumstances of the wet bulb temperatures is negligible.



Whenever the temperature inside an enclosure is maintained at a different level from that of the surrounding air, a transfer of heat takes place through the confining walls, floor and ceiling of the enclosure. The more conductive the walls, the more rapid the flow of heat for the same temperature difference and the more energy that must be supplied to maintain the desired inside temperature. If heat resistance in the form of insulation is interposed in the path of the heat flow, the loss of energy is retarded and a saving is thereby made.

Whether or not building insulation "pays" depends on many factors, such as average inside and outside temperatures, duration of heating or cooling season, period of operation, type of construction, cost of fuel or energy, cost of insulation, etc. In some cases it may be difficult to justify even a small thickness of insulation—if considered solely from the economic standpoint—whereas in other cases, up to 3 or 4 in. or even more may be needed. The type of conditioning involved—that is, whether industrial, commercial, or residential—is relatively unimportant, except so far as it affects factors which directly govern the thickness of insulation to be used (the inside temperature, the period of operation, construction, etc.). Heating and cooling problems are fundamentally the same, the essential difference being in the cost of heat or energy, the temperature differences and the periods of operation. Therefore, this article applies in general to summer conditioning as well as to winter conditioning.

Although the energy cost for summer air conditioning is higher than for winter air conditioning, this is offset by the greater period of operation required for winter conditioning. In general, a greater thickness of insulation is justified for winter conditioning than for summer conditioning, or to put it another way, for a given thickness of insulation the return on the investment for winter conditioning is usually greater than for summer conditioning—*usually*, but, of course, not necessarily always.

*Chief Engineer, Industrial Uses Department, The Celotex Company.

The Economics of Heat Transfer†

The principles relating to the economics of heat transfer apply in general to all temperature ranges and types of surfaces. This discussion is confined to ordinary temperatures and relates specifically to building construction and thermal building insulation.

Return on Investment

When a heat resistance (such as building insulation) is interposed in the path of heat flow, the rate of heat flow is, of course, reduced. Whether or not the application of this resistance is justified from an economic standpoint depends on the return on the insulation investment, which in turn depends on the monetary value of the heat or energy saved as the result of the retardation of the rate of heat flow during some period of time and the cost of the insulation during this period. The gross annual return on the investment (r) is expressed as a percentage as follows:

$$r = 100 \times \frac{\text{Value of Annual Fuel or Energy Saving}}{\text{Net Cost of Insulation}} \quad \ldots (1)$$

Example: Calculate the return on the investment for the following conditions and assumptions:

Construction: 4 in. concrete roof slab, built-up roofing and suspended metal lath and plaster ceiling (see Fig. 1). Location of building: Chicago. Inside temperature: 70 F. Average outside temperature during heating season: 36 F. Hours of operation: 18 hr per day, 210 days or 3,780 hr per heating season.

Insulation: Conductivity: 0.33 Btu per hr, per sq ft, per F, per in. thickness. Thickness to be used: 1 in. Installed cost: 10c per sq ft, per in. thickness.

†The material under this heading was presented by the author at the 42nd annual meeting of the *Society for the Promotion of Engineering Education* at Cornell University, June, 1934.

Coal: Calorific value: 13,000 Btu per lb. Efficiency of utilization: 60%. Cost per ton: $10.00.

The coefficients of transmission of the uninsulated and insulated roofs are 0.40 and 0.18 Btu per hr respectively, and the saving is 0.22 Btu per hr, per sq ft, per F difference in temperature. The average outside temperature in Chicago is about 36 F and since the nominal inside temperature is 70 F the average temperature difference will be 34 F. Multiplying

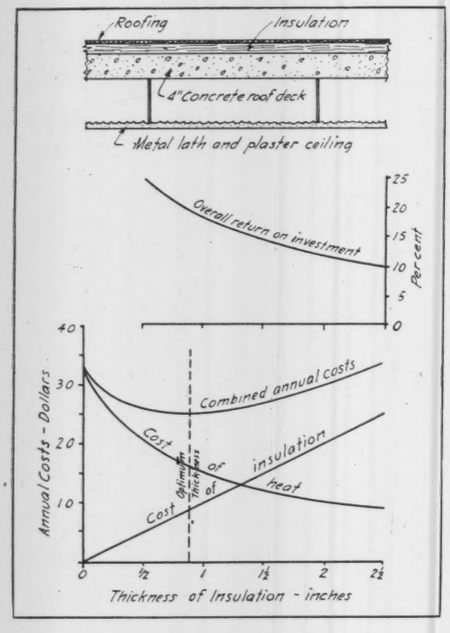


Fig. 1 (at top)—Roof construction considered in example of calculation of typical case showing return on cost of insulation. Fig. 2 (at bottom)—Cost of insulation, cost of heat, and combined annual costs for conditions assumed in example

the unit Btu saving by this average temperature difference, by the number of hours during the heating season (3,780) and by 1,000 sq ft, the unit area considered, the total annual Btu saving will be:

$$0.22 \times 34 \times 3{,}780 \times 1{,}000 = 28{,}200{,}000 \text{ Btu per heating season.}$$

If 13,000 Btu coal is utilized with an efficiency of 60 per cent, the net value of the fuel would be 7,800 Btu per lb. The fuel saving would therefore be:

$$\frac{28{,}200{,}000}{7{,}800} = 3{,}620 \text{ lb} \quad \text{or} \quad \frac{3{,}620}{2{,}000} = 1.81 \text{ tons of coal}$$

At $10.00 per ton, this would have a value of about $18.10. If the insulation cost is 10c per sq ft or $100.00 per 1,000 sq ft installed, the return on the investment will be:

$$100 \times \frac{18.10}{100.00} \quad \text{or} \quad 18.1\%$$

This example may also be solved by means of the following formula:

$$r = \frac{(U - U_1)JN(t - t_a)}{100\,(Z_1 - Z_u)} \qquad \text{.....(2)}$$

where

r = Return on the investment, per cent (whole number).
U = Coefficient of transmission of uninsulated wall or roof.
U_1 = Coefficient of transmission of insulated wall or roof.
Z_1 = Cost of insulated wall or roof, cents per square foot.
Z_u = Cost of uninsulated wall or roof, cents per square foot.
$Z_1 - Z_u$ = Cost of insulation installed, cents per square foot.
J = Cost of heat, dollars per 1,000,000 Btu $= \dfrac{500c}{C_e E_e}$ (for coal)
N = Number of hours during the heating season.
$t - t_a$ = Average temperature difference.
c = Cost of coal, dollars per ton.
C_e = Calorific value of coal, Btu per pound.
E_e = Efficiency of utilization of fuel, expressed as a decimal.

Substituting the proper values in this formula:

$$J = \frac{500 \times 10}{13000 \times 0.60} = \$0.64$$

Substituting in Equation 2:

$$r = \frac{(0.40 - 0.18) \times 0.64 \times 3{,}780 \times 34}{100 \times 10} = 18.1\%$$

The net return on the investment may be obtained by deducting the proper allowance for depreciation, insurance, maintenance and other charges. No allowance has been made in this example for the possibility of using smaller heating apparatus which saving is deductible from the cost of the insulation, thereby resulting in a higher return on the investment because of the lower net insulation cost. In certain extreme cases, especially where direct radiation is used, the dollar value of the radiation saving may amount to 50 per cent or more of the cost of the insulation.

Diminishing Return

Insulation follows the so-called law of diminishing return in that each successive increment pays a lesser return on the investment than the preceding increment, if the cost per increment remains the same. For example, in the problem cited the first ½ in. of insulation will pay a return of about 24.8 per cent, the second ½ in., 11.5 per cent, the third 6.6 per cent, the fourth 3.3 per cent, and so on.

Optimum Thickness

The question naturally arises as to the proper thickness of insulation to use in any given case. If no insulation is used, there is likely to be an extravagant loss of heat through the uninsulated structure. On the other hand, as successive thicknesses of insulation are added, the loss of heat during any given period diminishes but the cost of insulation during this period increases. At some point, the sum of these two quantities will be a minimum, and the thickness of insulation at this point may be considered to be the most economical thickness, or the optimum thickness.

The annual cost of heat per A square feet of area is equal to $\dfrac{AJN(t-t_a)U_i}{1{,}000{,}000}$. The costs for various thicknesses of insulation for the problem previously considered are given in Table 1.

The annual cost of insulation depends upon the allowance for interest on the investment, depreciation, insurance, repairs, etc., and is equal to ASx dollars, *where*

Table 1—Annual Heat and Insulation Costs per 1,000 Sq Ft of Area for Typical Problem

Thickness of Insulation (x)	Coefficient of Transmission (U_1)	Annual Cost of Heat	Annual Cost of Insulation	Total Annual Cost (m)
0"	0.40	$33.00	.....	$33.00
½"	0.25	20.60	$ 5.00	25.60
0.825"	0.20	16.50	8.25	24.75
1"	0.18	14.80	10.00	24.80
1½"	0.14	11.50	15.00	26.50
2"	0.117	9.90	20.00	29.90
2½"	0.10	8.25	25.00	33.25

A = area, sq ft, and $S = Pz \div 10{,}000$. (P = Annual fixed charges, per cent, and z = Installed cost of insulation, cents per square foot per inch thickness).

The annual insulation costs for various thicknesses based on an installed cost (z) of 10c per sq ft per in. thickness and fixed charges (P) of 10 per cent per annum are given in Table 1. These two costs are plotted on Fig. 2 as well as the combined cost. This chart indicates that the combined costs, for the conditions assumed, are at a minimum at about 7/8 in. of insulation which may be considered to be the most economical or the optimum thickness. The exact optimum thickness will be shown later to be 0.825 in. Of course, it is necessary in a given case to use the nearest commercial thickness.

In the foregoing example it was assumed that the insulation cost increases directly as the thickness increases, which in practice is not strictly correct. Ordinarily the cost per unit of thickness decreases as the thickness increases and hence the "cost of insulation" curve would not be a straight line as indicated. For this reason, a greater thickness than 7/8 in. might be justified in practice. Other assumptions used might also be debatable, but the figures used are, of course, illustrative.

In order to develop an expression for the most economic thickness of insulation, let

m = Combined annual heat and insulation costs, dollars

$$= \frac{AJN(t-t_a)U_1}{1{,}000{,}000} + ASx \qquad (3a)$$

$$B = \frac{JN(t-t_a)}{1{,}000{,}000}$$

$$m = BU_1 + Sx \quad (for\ A = 1)$$

$$= \frac{B}{\frac{1}{U} + \frac{x}{k}} + Sx \qquad (3b)$$

k = Conductivity of insulation, Btu per hr, per sq ft, per in. thickness per degree Fahrenheit

For the minimum value of m, $\frac{dm}{dx} = 0$ (3c)

Differentiating:

$$\frac{dm}{dx} = -\frac{BU^2k}{(Ux+k)^2} + S = 0 \qquad (3d)$$

$$x = \sqrt{\frac{Bk}{S}} - \frac{k}{U} \qquad (4)$$

Substituting the values previously used,

$J = 0.64$

$$B = \frac{0.64 \times 3780 \times 34}{1.000{,}000} = 0.0824$$

$S = 0.01$

$$x = \sqrt{\frac{0.0824 \times 0.33}{0.01}} - \frac{0.33}{0.40} = 0.825 \text{ in.}$$

Limiting Thicknesses

Although in this case, 0.825 in. is the most economical thickness of insulation for the conditions specified, it does not necessarily follow that it is uneconomical to use a greater or a lesser thickness. There are however certain maximum and minimum economical thicknesses in every case. The minimum thickness, of course, is the minimum commercial thickness of the material under consideration, provided that for the conditions involved this minimum thickness does not exceed the maximum economical thickness. In other words, this minimum thickness must pay a sufficient return to justify its use—otherwise, the minimum thickness is zero, or in other words, no insulation would be justified in this case for the conditions assumed, if considered solely from the economic standpoint or from the standpoint of the return on the investment.

"The heating engineer should not only recommend and specify the use of insulation and other heat conserving measures; he must definitely specify how and to what extent they are to be applied. It is only when this is done and done well that he is really serving those who depend upon him for advice."—*from Heat Conservation in Gas Heated Buildings, published by the American Gas Association.*

As previously stated, insulation follows the law of diminishing return. In other words, the first increment of thickness pays the maximum return on the investment and, if the cost per unit of thickness remains constant, each successive increment of thickness pays a smaller return than the preceding increment. Finally, the point is reached at which the return is no longer sufficient to justify a further increase in the insulation thickness. This limiting value may be considered the maximum economical thickness for the conditions involved and depends upon the return on the investment for the final increment of thickness.

Each increment of thickness preceding the final increment will pay a higher return than the final and consequently the overall return for the entire thickness of insulation will be higher than that for the final increment. Opinions, of course, vary as to the proper value of the return on the investment for the final increment of thickness. If however in a certain case the limiting value is taken to be 6 per cent, the return on the overall thickness may be 10, 20, or 30 per cent, or even more. Usually the overall return is sufficient to take care of depreciation, insurance, maintenance cost, etc., and in addition to pay a satisfactory return on the investment. In some extreme cases, neither the most economical thickness nor any other may be justified from the return on the investment.

The thickness of insulation based on the instantaneous return on the final increment of thickness as the limiting factor, may be determined from the following formula:

$$y = \sqrt{\frac{kNJ(t-t_a)}{100\,zI_r}} - \frac{k}{U} \qquad (5)$$

where

y = Thickness of insulation (inches) based on the instantaneous return on the final increment of thickness.

k = Conductivity of insulation in Btu per hr, per sq ft, per inch thickness.

U = Coefficient of transmission of the uninsulated construction.

I_r = Instantaneous return on the investment at the final increment of thickness.

z = Installed cost of insulation, cents per square foot per inch thickness.

Using the data given in the example previously cited and assuming the limiting factor to be a return of 6 per

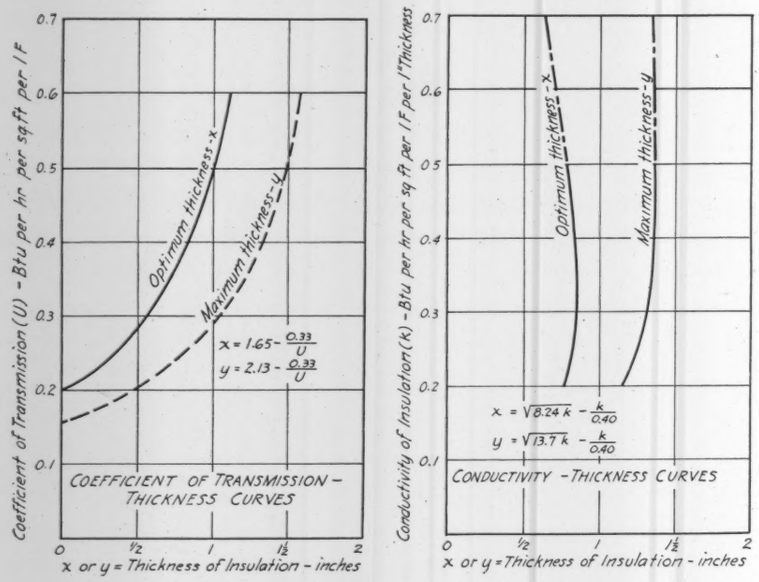

Coefficient of Transmission (U) - Btu per hr per sq ft per 1°F
Optimum thickness - x
Maximum thickness - y
x = 1.65 - 0.33/U
y = 2.13 - 0.33/U
COEFFICIENT OF TRANSMISSION - THICKNESS CURVES
x or y = Thickness of Insulation - inches
Conductivity of Insulation (k) - Btu per hr per sq ft per 1°F per 1" Thickness
x = √8.24k - k/0.40
y = √13.7k - k/0.40
CONDUCTIVITY - THICKNESS CURVES
x or y = Thickness of Insulation - inches

Fig. 3 (left) — Coefficient of transmission—thickness curves. Fig. 4 (right)—Conductivity—thickness curves

cent on the final increment of thickness, the overall thickness so determined by substituting in Formula 5 will be:

$$y = \sqrt{\frac{0.33 \times 3780 \times 0.64 \times 34}{100 \times 10 \times 6}} \frac{0.33}{0.40} = 1.3 \text{ in.}$$

Assuming that this were the actual thickness of insulation used, the coefficient of transmission for this construction would be about 0.155 and the overall return on the investment would be 15.5 per cent.

Variation in Insulation Thickness

An interesting analysis and comparison may be made by showing the variation in insulation thickness with each of the most important variables while the others remain constant, using Formula 4 for the most economical thickness and Formula 5 for the thickness based on the return on the final increment.

If in the problem used in this paper, all factors other than the coefficient of transmission (U) and the thickness are assumed to be constant, Formulas 4 and 5 will become, respectively,

$$x = 1.65 - \frac{0.33}{U} \quad \text{and} \quad y = 2.13 - \frac{0.33}{U}$$

The optimum thickness curve (Fig. 3) becomes zero when $U = 0.20$ for the specific conditions under consideration. At this value of U, the "maximum" thickness of insulation based on a return of 6 per cent on the final increment, is about ½ in. A 16 in. solid brick wall with plaster and wood lath on furring strips has a coefficient of 0.20. The limiting value of the optimum thickness is 1.63 in. and of the maximum thickness, 2.13 in.

Fig. 4 shows the relation between conductivity (k) and thickness. Fig. 5 shows the relation between the cost of coal (c) for the conditions of this problem and the thickness. The curves for the number of hours during the heating season (N) and the average temperature head (t—t_a) will have the same form. Fig. 6 shows the relation between the cost of insulation (z) and the thickness. The curves for the fixed charges (P), instantaneous return (I_r), calorific value of coal (C_c), and heating efficiency (E_c) will be similar.

Special Conditions

In the discussion thus far it has been assumed that the manner of installation of the insulation is such that the only change in the heat resistance of the construction under consideration is that due to the addition of the insulation. In certain types of construction, the increase in the heat resistance is not due entirely to the heat resistance of the insulation added and a correction must therefore be made. This situation prevails under the following conditions:

1. Insulation used in place of other materials in the construction as for example, for sheathing and plaster base.
2. Insulation installed in a manner such that the number of air spaces is increased.
3. Insulation installed in a manner such that the number of air spaces is decreased, such as when a so-called fill is used and applied between studding.

There are several ways of solving these problems. One

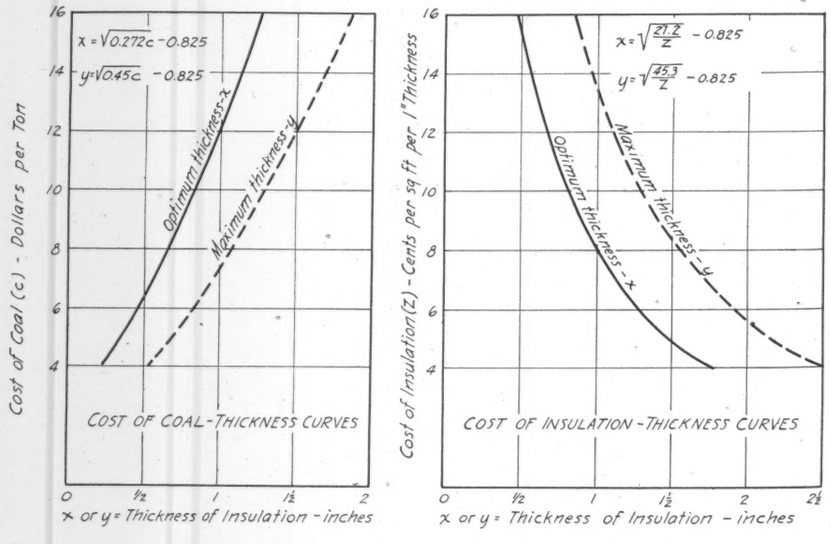

Cost of Coal (c) - Dollars per Ton
x = √0.272c - 0.825
y = √0.45c - 0.825
Optimum thickness - x
Maximum thickness - y
COST OF COAL - THICKNESS CURVES
x or y = Thickness of Insulation - inches
Cost of Insulation (z) - Cents per sq ft per 1" Thickness
x = √21.2/z - 0.825
y = √45.3/z - 0.825
COST OF INSULATION - THICKNESS CURVES
x or y = Thickness of Insulation - inches

Fig. 5 (left)—Cost of coal—thickness curves. Fig. 6 (right) — Cost of insulation — thickness curves

method is to calculate the return on the investment for the conditions involved and for the manner of installation and to ascertain whether or not the return is sufficient to warrant the expenditure. In the case of wall fills, for example, the return for the one condition under which this material may be applied either is justified or is not justified. This method may also be used where the insulation is used in place of other materials or where the insulation is applied in such a manner as to provide one or more additional air spaces. Where several thicknesses of an insulation are available the economic thickness may be determined by plotting curves similar to those shown in Fig. 2 and ascertaining the thickness which will result in the minimum combined cost of heat and insulation. In some cases, it may be sufficiently accurate to disregard any change in the number of air spaces or any replacement by the insulation of other materials used in the building construction such as the plaster base, and to determine the insulation thickness according to the principles discussed in this paper.

In the case of new buildings, where a reduction in the size of the heating plant or in the required amount of radiation is possible as the result of the use of insulation, this should be considered when arriving at the economic thickness of insulation.

Insulations, of course, vary in price, efficiency, and general physical characteristics. No attempt has been made in this paper to suggest a rule for determining the proper type or kind of insulation to be used in any given case.[1] If considered solely from the standpoint of heat resistance, the material to use in any case would be that material which provides the maximum heat resistance per unit of applied cost, but other factors may be of equal or greater importance than the sole consideration of heat resistance, such as strength, durability, waterproofness, resistance to dry rot, fungus, termites, etc. The proper thickness of any specific type of insulation to use may vary over a considerable range, depending on the conditions, and for a project of any considerable magnitude, the thickness to be used should be determined on some intelligent basis.

Thermal insulations often are selected on the basis of other considerations than the tangible economic value such as for the prevention of condensation and reduction of the rate of heat transfer during the summer. Even in such cases they may have some economic value, for wherever heat or refrigeration is required to maintain a specific temperature, insulation will permit the maintenance of the desired temperature more economically.

[1]See "Five Suggested Methods of Appraising Insulations," by Paul D. Close (*Transactions, American Society of Heating and Ventilating Engineers, Vol.* 35, 1929).

Pipe Welding—

(*Continued from page* 500)

tion and erection, leaving the planning to engineers trained in this work.

As the third important step in conducting the job on a production basis, procedure in shop and field is designed to relieve the welder of all duties except that of welding. In this way he may concentrate fully on his work in the interest of weld quality and good production. Since the welds are as important to the completed job as the pipe or welding fittings, it is only to be expected that every care should be taken in making them, yet that their production be facilitated in every way possible. Since the operator is free to do nothing but weld, the amount of production to be expected each day can be gauged fairly accurately. Thus the length of time needed to complete a certain line, with one or more operators at work on it, can be estimated closely and the schedule for the entire job balanced accordingly.

The fourth move, eliminating a constant source of confusion on the job, was considering each line from terminal to terminal as a distinct unit just as though it were a tank or other piece of equipment. Each line is given a definite designation, and all shop drawings, bills of material and work orders refer to this line number. The line is fabricated in easily handled sections in the welding shop and is assembled on the job as a unit, without any stopping until completed.

The fifth factor is placing responsibility for the welding. This is given to one man, the welding foreman, who has under him a number of sub-foremen who actually direct and supervise the welding. The welding foreman is in direct charge of the welding shop where all piping is fabricated before being sent to the job for erection. He is also responsible for welding done on the job, whether for erection, alteration or repair, and he loans operators together with their welding equipment to other foremen for this purpose. Actual erection is in charge of pipe fitting foremen, both they and the welding foreman coming under a general mechanical foreman.

The last factor has to do with the amount of welding done in shop and field. It was soon recognized that shop welds, being made under conditions approaching more closely the ideal, could be made with less supervision and at lower expense than welds in the field. Consequently a line is broken up into as few units as possible for fabrication, based on the size and weight of sections that can be readily handled, thereby keeping the number of field welds to a minimum.

It is around these six factors then that the plan of operation is laid out: (1) shop fabrication of all lines in good-sized sections, with assurance of ready assembly in the field; (2) giving each individual in the organization a minimum number of duties, to the end that efficiency is increased; (3) giving the key workman in the organization, the welder, nothing to do but welding so that quality and production will be uniformly high; (4) considering the entire piping job as divided into a number of unit lines, each a separate item of equipment; (5) placing the responsibility for all welding, because of its importance, under a welding foreman; (6) and performing the greater part of the welding in the shop where it can be done economically and speedily.

Piping Layout and Steam Pressure Control in Steam Generating Plants

By E. C. Gaston*

. . . . Proper Location of Controller with Reference to Piping Layout Needs Careful Attention

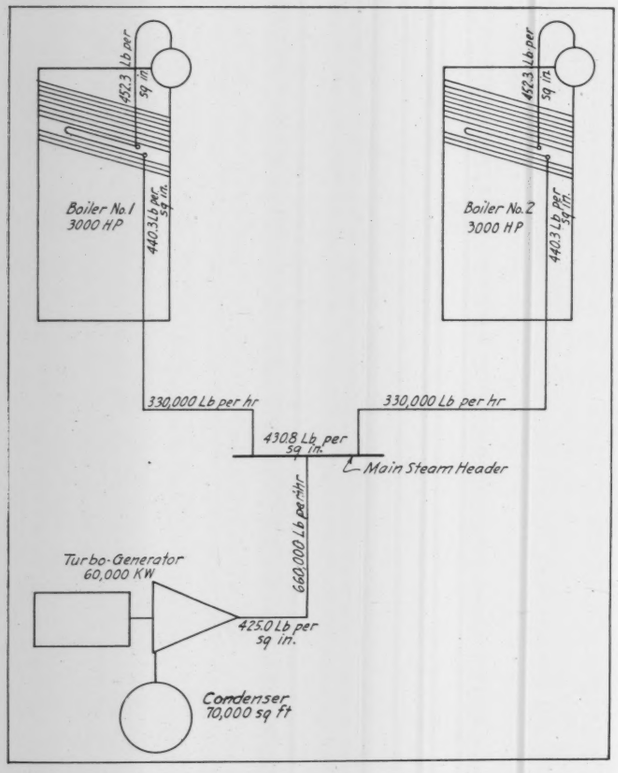

452.3 Lb per sq in.
452.3 Lb per sq in.
Boiler No.1 3000 HP
Boiler No.2 3000 HP
440.3 Lb per sq in.
440.3 Lb per sq in.
330,000 Lb per hr
330,000 Lb per hr
430.8 Lb per sq in.
Main Steam Header
660,000 Lb per hr
Turbo-Generator 60,000 KW
425.0 Lb per sq in.
Condenser 70,000 sq ft

Fig. 1—Diagram of main steam piping for example given in text

CAREFUL attention to the location and design of combustion control equipment with reference to the piping and the plant layout is necessary to proper and economical operation of steam generating plants. All steam boiler plants are subject to variations in steam demand, these variations being more pronounced in some plants than in others—greatest in plants supplying process steam, and in central stations that are used to swing peak loads and control speed on interconnected electrical transmission systems.

It is the prime duty of the boiler plant to meet these variations in steam load. Assuming that the boilers have adequate heating surface for maximum demand; that steam releasing space of the drums is large enough to prevent moisture carry-over at high ratings; that furnace volume is liberal and of proper dimensions; and that fuel burning and draft equipment is properly designed and proportioned, the next problem is to provide proper control equipment correctly installed.

Each change in steam demand requires a change in fuel and air supply to the boiler, and if the operation is to be satisfactory and at maximum efficiency, the changes in fuel and air supply must be simultaneous and in proportion to the change in steam demand. If the fuel and air supply are not correctly adjusted there will be a change in steam pressure with each fluctuation in steam flow. It is not the purpose of this discussion to describe or compare in detail the designs and operating characteristics of the various types of control apparatus; but rather to discuss its installation in relation to the piping.

The master sender is the heart of the control system, its action or impulses being transferred either directly or indirectly to each of the auxiliary controllers. The master sender receives its impulses from variations in steam pressure; should it be located at the boiler drum, at the turbine throttle, or at some intermediate point in the piping, and what is the effect its location will have on the operation of the turbine?

Steam Pressure in Piping Varies

The steam pressure varies from the boiler drum outlet to the turbine throttle, due to the resistance of flow through the piping. A pressure difference is created in order to produce the velocity with which the steam leaves the drum nozzle. Other losses are created by the superheaters, non-return valves, stop valves, fittings, and by friction in the pipe connections and headers.

If the pressure in the boiler drum is held constant for all rates of steam flow, then the increased pressure drop in the piping at heavier loads will reduce the pressure at the throttle below that desired. Such an operating condition usually is not desirable as the reduced pressure at the turbine throttle at the time of maximum loading, due to increased steam flow, results in a decrease in power output and a slight loss in efficiency.

*The Commonwealth & Southern Corporation, Birmingham, Ala.

Fig. 1 shows a diagram of main steam piping from two 3,000 hp boilers to one 60,000 kw turbo-generator designed to operate with steam at the throttle at 425 lb per sq in. pressure and 725 F total temperature. When operating at 60,000 kw load this unit, with full four-stage extraction for feedwater heating, will require 660,000 lb steam per hr, and it will be assumed that each boiler will supply one-half of this amount. In order to show the effect of the location of the master controller on the operation, it is necessary to determine the pressure drop between the boiler drum and the turbine throttle, with the unit operating at full load.

Fig. 2 shows the pressure loss through the superheaters for various boiler outputs. To determine the additional drop due to valves, fittings, pipe friction, etc., the piping will be divided into two sections; namely, that between the superheater outlet and the main steam header, and that between the header and the turbine throttle. In calculating the pressure loss from the superheater to the main steam header, the following data are known:

Steam flow, 330,000 lb per hr; Pipe size, 14 in. O. D. (600 lb Std.); Pipe length, 150 ft; Added length for valves, bends, and fittings, 250 ft.

From Babcock's formula for flow of steam in pipes, the pressure drop in this line is as follows:

$$P = K \frac{M^2 L}{D d^5} \left[1 + \frac{3.6}{d} \right]$$

Where P = pressure drop, lb per sq in.; K = constant = 0.0001321; M = steam flow, lb per minute; D = density of steam, lb per cu ft; d = inside pipe diameter, in.; and L = length pipe line, ft.

$$P = 0.0001321 \times \frac{(5500)^2 \times 400}{0.653 \times (12.7)^5} \times \left[1 + \frac{3.6}{12.7} \right]$$

$P = 0.0001321 \times 56{,}000 \times 1{,}284 = 9.5$ lb per sq in.

Following the same procedure as above, the pressure drop from the main steam header to the turbine throttle is as follows (Steam flow, 660,000 lb per hr; Pipe size, 18 in. O. D. (600 lb Std.); Pipe length, 125 ft; Added length for bends and fittings, 100 ft):—

$$P = 0.0001321 \times \frac{(11{,}000)^2 \times 225}{0.653 \times (16.4)^5} \times \left[1 + \frac{3.6}{16.4} \right]$$

$P = 0.0001321 \times 35{,}700 \times 1.22 = 5.8$ lb per sq in.

With the unit operating at its full rating of 60,000 kw, then the total pressure drop from boiler drum to turbine throttle is:

Superheater loss	12.0 lb per sq in.
Loss—superheater outlet to main steam header	9.5 lb per sq in.
Loss—main steam header to turbine throttle	5.8 lb per sq in.
Total pressure drop	27.3 lb per sq in.

Control of Pressure at Proper Point Important

The turbine is designed for operation with steam delivered to the throttle at 425 lb per sq in. pressure. If the control equipment operates to maintain constant pressure in the boiler drum at all times, and if the unit is to float on the line at no load, then the boiler drum pressure must be held constant at approximately 425 lb pressure, since the turbine requires only 40,000 lb of steam per hr at no load and the pressure drop from boiler drum to turbine throttle is less than 1.0 lb per sq in. under this condition.

By maintaining constant boiler drum pressure, the pressure at the throttle is reduced to 397.7 lb per sq in. when the unit is operating at full load. This reduction

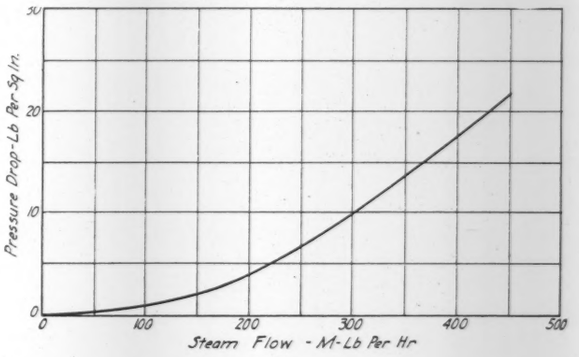


Fig. 2—Pressure drop through superheater (see example in text)

in pressure will result in a loss in power produced from the unit. The reduction in power output can be approximated as follows:

Turbo-generator efficiencies (assumed):	
Rankin cycle	81.5%
Mechanical	99.0%
Electrical	98.0%
Total overall	79.0%

From the Mollier chart the properties of the steam at the throttle and at the exhaust, assuming 100 per cent efficiency and exhaust at 2 in. Hg back pressure, are as follows:

	Btu Per Lb Steam	
	425 Lb Throttle Pressure	397.7 Lb Throttle Pressure
Steam at throttle	1374.0	1374.0
Steam at exhaust	917.0	922.0
Heat available for work	457.0	452.0

With an overall engine efficiency of 79.0 per cent, the actual heat converted to electrical energy becomes 361.0 Btu per lb for steam at the throttle at 425 lb per sq in. pressure, and 357.0 Btu per lb for steam at the throttle at 397.7 lb per sq in. This means that for every pound of steam admitted to the turbine there is 4.0 Btu less, available for work. Expressed in percentage this represents, 4.0/361.0 = 1.11 per cent loss, or a reduction of 666 kw in power output. That this is an appreciable loss can best be illustrated by assuming that the unit be required to operate 4,000 hours annually at full rating; in this case the loss in power generation would amount to more than 2.5 million kwh.

The above analysis shows the need for careful attention to the location and design of steam pressure control equipment with reference to piping and plant layout. Economy and modern practice indicate that the main steam pressure shall be regulated and kept constant as near the turbine throttle as layout of the equipment and piping and other practical conditions will permit.

CHOOSING *the right* AIR CONDITIONING SYSTEM

By **A. Warren Canney***

WHAT are the variables comprising the possible objectives of an air conditioning system? Such a question would probably not be answered exactly alike by any two air conditioning authorities, for air conditioning practice is infinitely ramified.

This diversity of practice is as it should be. This series of articles will explain why this is so and why—to a large extent—it will always be true. Proper air conditioning practice is based on the premise that to fulfill the objectives of a specific installation both the designer and the equipment must follow Bacon's sage truth: "To command Nature you must obey her." The word "scientific" is but a synonym for this quotation. Air conditioning provides the first scientific approach to human comfort in history. *Rule-of-thumb methods have no secure place in this art,* but definite types of equipment can and have been developed for limited conditions of similar requirements.

In this article, therefore, we will further attempt to provide at least one secure foundation for equipment methods and selection (perhaps the first attempted, and with the inherent imperfections of all first things) which must necessarily be a very broad basis, while affording a means for dove-tailing these system requirements with the most common practices found in actual installations.

To do this, the procedure suggested here is to think of the objectives first and what will scientifically fulfill them afterward. With this approach it becomes possible to "scale downward" intelligently—say for price considerations—rather than to select methods or equipment first and attempt to modify these by "scaling upward" to meet the various auxiliary and detailed *fundamental* requirements. Then, as pointed out in the preceding article, equipment methods can be legitimately compared.

The Objectives of an Air Conditioning System

These might be listed as follows, with each given due consideration:

1. The use to which a system is to be put.
2. The owner's requirements and/or "degrees of constancy."
3. Functional requirements.
4. Technical requirements.
5. Method of operation.
6. Mechanical considerations.
7. Physical requirements.
8. Degree of quietness required.
9. Operational security, or importance of continuous performance.
10. The items of importance.

*Air Conditioning Engineer of the Staff of Clyde R. Place, Consulting Engineers, New York City.

This article continues the series inaugurated last month with a discussion of the proper viewpoint toward air conditioning.

1. The use to which a system is to be put broadly establishes the character of the entire installation. In a proposed installation it is vitally important that a purchaser be able to tell the engineer which items concern him most. *This point is essential.* For example, architectural considerations might take precedence over proper air distribution. Of course, the technique of air conditioning lies in sacrificing neither.

But the degree of activity of the occupants; the type of activity; climatic factors; dissimilarity in acclimatization to indoor conditions in summer among people, such as attendants and customers; whether people other than the individual purchaser will have to experience the results produced by the system; and their relative sensitiveness or "criticalness" all affect the degree of refinement to which a system should be carried for satisfaction. Factors such as these influence (a) the segregation of control; (b) the toleration limits of control; (c) the speed of response of the system to change conditions to those more suitable.

The fact remains that despite comfort zones people are different in their physiological response, and thus the grade of installation either required or that which an owner intends to provide materially influences the cost of a system.

At this point it should be fixed whether control is to be effected (a) entirely by manual regulation of occupants; (b) partial regulation by occupants; (c) complete operation provided for the occupant or occupants.

This influences enormously the character and cost of the system. Occupant regulation is cheapest of course with central plants where large areas with individual spaces are served. Under the same conditions unit type equipment in each room or partitioned compartment may be the more expensive way to provide occupant control. Balanced against these are the possibilities of economies effected during shutdown periods in the individual conditioned spaces.

One of the chief factors which is determined by the usage is the indoor condition to be maintained, and how it is to be varied for the local outdoor weather conditions. This fixes to a large measure the capacity and hence the initial cost.

Thorough analysis of usage is therefore of primary importance for reasons of cost and success of the job.

Moreover these variations must not be excessively quick. Also the demands made on changes in metabolic rate to compensate for changes in "thermal environment" extraneous to the body must not be too sudden in the particular instance of an increase, such as occurs

Part 2 — Air Conditioning Methods, Equipment and the Problems they Present

when entering an over-cooled space in summer from a high outdoor thermal level. Of course, the proportioning of the total body heat generated between the several ways of body heat loss for different conditions of activity become controlling, in accordance with the researches of the *American Society of Heating and Ventilating Engineers*.

This generalized aspect is presented merely to show that sufficient study should be made to know where and when further study is required and in what direction.

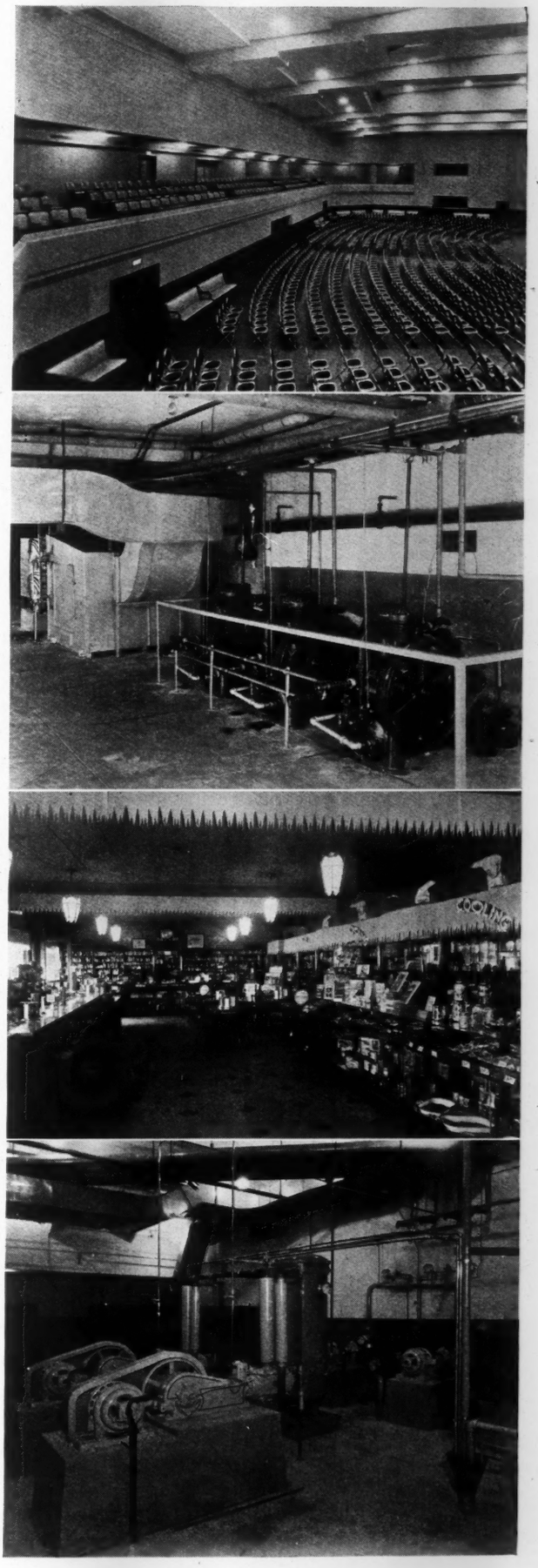
2. Buyers should be aware—or beware—of "degrees of constancy." The man who pays for anything is entitled to receive what his money is contracted to yield. In this respect there lies an inherent weakness in the purchasing of air conditioning without experienced advice. The reason for this is that there are simply too many mechanical possibilities and combinations of factors all told which can be brought within the province of air conditioning.

After informing the engineer what use or uses the system will be put to in terms of the human equation, the prospective buyer might well psychoanalyze himself, or by some other method establish what degree of laxity he will permit from the proper air conditioning basis of establishing and constantly sustaining correct indoor atmospheric conditions as tabulated in last month's article.

After doing this with each atmospheric function of proper air conditioning (temperature, relative humidity, wholesomeness, odor and visible fumes such as cigarette smoke) he should confer with the engineer and establish either how many hours or what percentage of total operating hours of anticipated use he will tolerate these definite sacrifices, then have the engineer balance these against initial and operating costs. While this is usually neglected, it is the only intelligent procedure to the price warring which purchasers themselves institute. Otherwise, the basis of retaining the party who knows what the job should receive is the safest and most sure procedure with minimum distraction over the acquirement and life periods of the equipment.

The author advocates the plan that all air conditioning be thought of in terms of "constancy" of indoor conditions. Air conditioning being what it is, control becomes the essence of the whole subject; that is to say, control over all major functions, not merely temperature and relative humidity.

In this we see degrees of things in accordance with what a buyer will pay for and what he expects to re-



TOP TO BOTTOM

Largest radio broadcasting studio in the world (N.B.C. at Radio City). Studio air conditioning represents a special application of comfort air conditioning where the health and comfort of artists is a vital consideration. . . . Three freon compressors for air conditioning a hotel lounge and coffee shop. . . This drug store has made a neat application of units. . . Auxiliary equipment in a central station plant at Rockefeller Center, New York

ceive. Certain equipment is properly designed to permit mass production of devices which have specific limitations in performance and function but which, within these limits, fulfill many buyers' requirements.

Thus, the owner—or his engineer, either for him or in collaboration in an amount dependent on the skill and wisdom of both—must have a mutual understanding on the *degree of constancy* both required and acceptable. Herein lies one great pitfall of much commercial air conditioning practice.

3. Next, the functional requirements of the system should be established. These may be readily tabulated as follows:

1. Summer—cooling only.
2. Summer—dehumidifying only.
3. Summer—evaporative cooling only.
4. Summer—cooling and dehumidifying.
5. Air recirculation, intermediate seasons (Spring and Fall).
6. Uncertain new outdoor air supply.
7. Positive new outdoor air supply, removal and replacement.
8. Any proper combination from (1) to (7), plus heating.
9. Item (8) plus humidification.
10. Any proper combination from (1) to (7), supplementing heating.
11. Item (10) plus humidification.
12. Any proper combination of items for "constancy."
13. Any combination of items for "partial constancy."
14. Any selected group of items with or without filtration, ionization and/or other treatment.
15. Smoke exhaust as required.

4. The fundamental technical requirements of air conditioning are chiefly divisible into the classifications of those spaces to be served in the same building, job or plant which have:

(a) the same or different atmospheric requirements,
(b) similar or dissimilar thermal characteristics in the different spaces to be served during the usage of the equipment at any time.

NOTE: Technical considerations will be further amplified in articles to follow.

5. The proposed method of operation is of great importance. This is tied up, as indicated previously, with the amount of interruption of the occupant or occupants permissible, to control their own conditions. In this latter case this is usually confined to temperature and/or air volume control by occupants and relative humidity as affected by both. This also depends on the number and type of attendants as well as the maintenance labor cost permissible. The location of equipment for instance will have considerable bearing on this item. Also, the matter of remote control, or centralized control, or no automatic control at all, have direct bearing on both satisfaction and investment costs.

6. The mechanical considerations are indeed numerous as these involve the many physical methods of accomplishing a given result which, as we have seen, is the control, or intelligent partial control over specific atmospheric conditions in the individual spaces served.

In general, where the functional requirements are within the classifications previously set forth and numbered (4) to (7) inclusive, metallic surfaces for heat absorption by the direct expansion of refrigerant or by chilled water circulation might be used. With requirements (4) and (5) only, self-contained units may be set in each room and readily hooked up. The self-contained units require some job mechanical work to include items (6) or (7). By sealing off the spaces served to reduce crackage, and adding properly designed mechanical exhaust, self-contained units (meaning complete devices with refrigeration, duct work or not) can then and only then be brought within the scope of Item (7).

Some standard equipment provides a water spray which keeps the metallic surfaces wet at all times, this same spray being used for evaporative cooling and winter humidification. It makes a difference whether this spray keeps the metal surfaces wetted.

A chemical dehydrator must be used to effect Item (2) only.

Note that Items (8) to (11) include winter operation. This may be done by either standard product units which embrace all the functions selected, by an assembled job using different metallic surfaces for summer and winter (or the same surface using hot water in winter and cold water in summer), any of these possibly supplemented by a means for humidification. Observe that the recirculated water spray is a universal adjunct for the fulfillment of all seasonal requirements, and need only be supplemented by the proper heating requirement.

The principles of all other adjuncts to a proposed air conditioning design are the same, such as the requirements for recirculation, etc. This does not complete the discussion of mechanical method as this involved consideration will be further amplified in later articles.

7. The physical conditions to be encountered have an obvious influence in a hundred various ways, from the strength of the building members to architectural considerations, or mere appearance in the eyes of the owner. This does not require any elaboration, but the physical conditions as related to a variable tenancy exert a profound influence on design, the technique for which has only recently been developed and applied, particularly to very large structures. Note also that under these conditions of variable tenancy, provision must be made for the complete latitude necessary for variable thermal requirements to be encountered.

Up until a few years ago all air conditioning practice was based on the physical and thermal requirements known fully in advance of design. The selective system (such as that now being incorporated in Rockefeller Center's thirty-eight story office building) will set a major precedent in the technique required for meeting the complication of variable tenancy.

8. The degree of quietness required is included as an item of importance in our list because of its potential influence on both owner satisfaction and cost. Suffice it to say here that the only way to assure protection is to make certain that sound levels will be met on a truly scientific basis without guesswork.

9. The matter of operational security is influenced by the standards set for the equipment, purchasing equipment which is definitely out of the experimental stage, and the economical provision against breakdown and the precluding of poor results or performance interruption.

This item also includes hazards of whatever nature, down to possible small water leaks, refrigerant leaks or flooding, even though but a carpet become soaked.

10. Next recapitulate the items surrounding the system that are of major importance to you as the owner: After considering these and other general or specialized items, it is well to take a perspective on the primary objectives of the investment, proportion the costs accordingly without sacrificing other important

CLASSIFICATION OF TYPES OF AIR CONDITIONING SYSTEMS

This tabulation classifies types of air conditioning systems as generally as seems possible. The list is represented in its entirety by actual practice.

A: STANDARD PRODUCTION EQUIPMENT—

1. Self-contained summer room units with either—
   (a) full automatic control by temperature.
   (b) partially automatic control.
   (c) manual control.
2. Same as (1) but less quiet in operation for basement or closet locations.
3. (1) and (2) with or without recirculation.
4. (1), (2) and (3) but with sufficient static fan resistance for duct work so as to represent in effect a miniature central plant.
5. (1), (2), (3) and (4) with or without outdoor air connection provided for.
6. (1) to (5) with or without provision for winter humidification—
   (a) automatic control from hygrostat.
   (b) no provision for control.
   (c) manual control.
7. (1) to (6) arranged so that the fan may be operated independently by means of some external switch.
8. (1) to (7): Refrigeration separate for same or different location of air handling unit—
   (a) direct expansion.
   (b) chilled water circulation.
9. Items (1) to (8): Refrigeration of almost any type except toxic, explosive or high pressure refrigerants under ordinary operating conditions as locally approved by law.
10. Items (1) to (9) with water spray—
    (a) constant from street pressure for wetted metallic surface.
    (b) humidification only.
    (c) a plus b with or without recirculation pump.
11. (8) to (10) involving one refrigeration unit serving several combination air handling and heat absorption units.
12. Two or more arrangements of Item (11) within the same premises.
13. Cooling units only.
14. Dehumidifying units only for absorption of water vapor chemically.
15. Item (14) supplemented by mechanical refrigeration for air cooling only by heat absorption through metallic surfaces by—
    (a) direct expansion.
    (b) chilled water circulation.
    (c) sprays.

(This requires ductwork and is also practiced under *CLASS C* "central station" types of systems.)

16. Evaporative cooling units only.
17. Humiditying units only—
    (a) portable.
    (b) duct insertion.
    (c) apparatus attachment.
    (d) radiator attachment.
    (e) residential types.
18. (1) to (17) inclusive for—
    (a) floor mounting.
    (b) ceiling mounting.
    (c) wall mounting.
19. Units containing two or more individual fans and drives as standard.
20. Belt drive or direct fan drive.
21. Units requiring ice.
22. Units with or without heating coils—
    (a) additional
    (b) or summer coil for water used with hot water in winter.
23. Winter units only (mostly residential) for—
    (a) hot water or
    (b) steam from—
        (1) Any other source or type of controlled pressure furnace.
        (2) Self contained with—
            (a) gas heating element integral.
            (b) oil heating element integral.

All these are equipped with some form of humidifier and many provide for air circulation during seasons other than winter, and some are built—

   (a) for refrigeration attachment.
   (b) refrigeration self contained.

B: JOB-FABRICATED SYSTEMS EMPLOYING METALLIC AIR HEAT ABSORPTION SURFACES WITH DUCTWORK—

24. For single systems (up to 25 tons per bank of coils)—
    (a) direct expansion.
    (b) chilled water.
    (c) brine.
25. Same as (24) but one refrigeration unit with heat absorption surfaces at several locations.
26. Two or more systems as in (25), in the same premises.
27. With or without recirculated water spray over exterior of surface.
28. With or without winter humidification.
29. With or without means of winter operation for—
    (a) heating.
    (b) supplementing heating.
30. Controllable—
    (a) full automatically.
    (b) semi-automatically.
    (c) manually.

C: CENTRAL STATION SYSTEMS FOR SMALL OR LARGE SYSTEMS. JOB-FABRICATED SYSTEMS EMPLOYING SPRAYS AND DISTRIBUTING DUCT WORK—

These can be arranged to provide any of the fifteen functional requirements given except Item (2) *alone*, making a total of forty-four general types of systems so far. Any of these might be furnished in the following arrangements—

45. One refrigeration unit or plant in the building serving—
    (a) one air treating and handling equipment in the same or in a different space.
    (b) two or more air treating and handling equipments in—
        (1) the same space with refrigeration;
        (2) grouped in different spaces as on different levels;
        (3) all in different spaces.

(46-52) Note: This is equally applicable to all *Class B* items, making system combination Items 46 to 52.

53. More than one refrigeration unit with same potential subdivision as (45), all on the same air treating equipment, or segregated.
54. Two or more fans in parallel on one air treating apparatus.
55. Two or more fans in series on one air treating apparatus.

D. COMBINATION SYSTEMS—

56. Combination systems with central station and—
    (a) one or more units each serving one or more spaces, or
    (b) one or more units, each serving individual spaces.
57. Combination systems with one central refrigeration plant, pumping chilled water or brine to individual units of the—
    (a) standard product type with or without ducts.
    (b) miniature central station plant type with or without duct work:
        (a) standard product elements.
        (b) job fabricated elements.

E: SPECIAL PATENTED UNIQUE AND UNUSUAL TYPES OF SYSTEMS OR METHODS.

58. Any of the above systems employing mechanical refrigeration, as most of them do, may utilize street water for condensing or "atmospheric evaporators" (better known as cooling towers).
59. In general, refrigeration may be electric, chemical, reciprocating; electric, chemical, centrifugal; steam or gas absorption; steam-jet, water vapor; steam turbine or electric water vapor centrifugal; or steam turbine, chemical, centrifugal.
60. Electric or pneumatic controls or a combination of these may be used for any apparatus listed herein.

In all the above, it is seen that numerous combinations of equipment are possible.

---

items, and then resting secure in the knowledge that the installation will be really successful without trouble or misgivings.

It is hoped that the above can serve as an aid to better guide prospective purchasers of air conditioning.

After having set up the objectives, it becomes possible to balance one method against another or to ascertain definitely the limits of equipment or types of systems for the job at hand.

Air conditioning systems are therefore classified as generally as possible in the accompanying tabulation. It should be remembered that considerable care and study is required to select the right method unless certain obvious or highly important objectives become controlling.

This list is represented in its entirety by actual practice. The only way to bring a semblance of order out of such a wide variety of equipment and methods is to show the actual considerations which influence choice, and illustrating this by citing known examples. In this way the elements governing a choice of the combinations of apparatus listed will be clarified.

The next article in this series will discuss basic differences between the central station and unit methods.

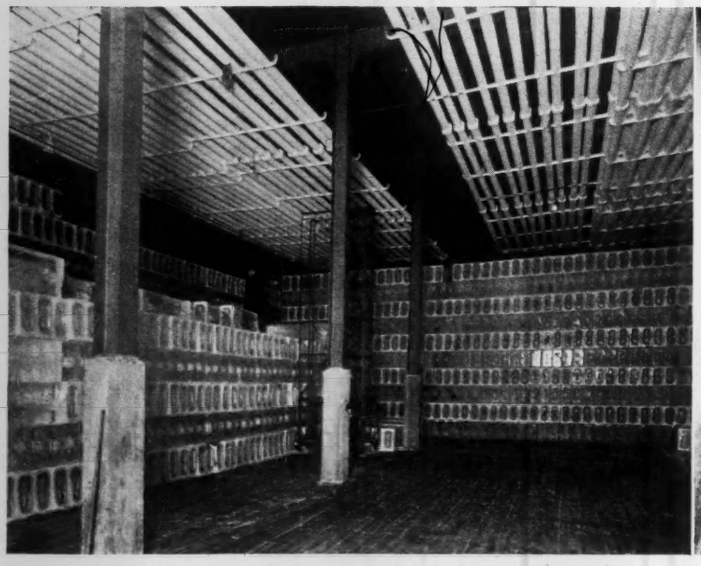


Fig. 1—Winter ice storage room, showing pipe coils which maintain temperature of 28 F. Fig. 2 (right)—Limited space in brewery storage rooms requires ingenuity in installation of piping. Note double offset in refrigeration piping around the drain pipes

Methods of Installing Refrigeration Piping

By **Robert S. Wheaton***

LIKE high and low pressure steam, water, compressed air, and other fluids, refrigeration is an important industrial service which is largely a problem of piping. The installation of refrigeration piping for various applications requires care both in planning and in the actual erection; this article is a brief description of the practical considerations involved in piping refrigeration for two typical services.

One application of industrial refrigeration piping is in the manufacture of ice for supplying refrigeration in winter ice storage rooms (Fig. 1). The ice manufacturer makes ice in the winter when low outdoor temperatures and the cold condensing water results in a lowered condenser pressure and a lowered heat transmission loss, thereby decreasing the power cost per ton of ice produced. With the advent of warm weather and increased demands for ice the daily plant capacity is augmented by withdrawing ice from the so-called winter storage to take care of peak loads. It is of interest to note that the ice cakes, slightly tapered in form to facilitate removal from the ice cans, are piled with the tapered sides reversed in each tier so that the cakes will not slide off the pile. An elevating machine is used to raise the ice cakes to the required levels and to lower the cakes to the floor.

Pipe coils for this work are usually made of 2 in. full weight black pipe, galvanized pipe not being considered necessary as the coils are always in service holding the storage at about 28 F so that there is no water present on the coils to cause rust formations. Hot gas connections are not used in this work to melt the frost from the coils as the moisture dripping would tend to freeze the ice cakes together. The frost accumulations are scraped off by the operator when they become too heavy.

Frost formation must always be given due consideration when designing the hangers and bearing bars. For 2 in. full weight pipe it is good practice to allow a weight of 11 lb per lineal foot for the weight of the pipe, hangers, bearing bars and frost. The hangers are often placed at 8 ft intervals in the length of the coil and at 4 ft centers across the coil, although the intervals in the length of the coil have sometimes been as much as 12 ft.

The coils illustrated in Fig. 1 are made up with pipe return bends and 20 ft pipe lengths fitted with drop forged steel flanges soldered and sweated to the pipes. Another method of construction is to use 40 ft lengths of pipe with plain ends and to weld the pipe together on the job. About 2200 ft of 2 in. pipe may be served by one expansion valve. A good trick is to place a stop valve on each side of the expansion valve to allow the expansion valve to be removed for repairs without pumping out the coil. The gas velocity out of the coils should be kept at around 960 ft per min. The heat transfer is usually calculated at 1.4 Btu per sq ft of pipe surface per degree Fahrenheit temperature difference per hour, with medium frost formations on the pipe coils.

Placing the refrigerating pipe coils in brewery beer storage rooms is a refrigeration piping problem in which difficulties are sometimes encountered. In the brewery cellar shown in Fig. 2 it was desired to place the pipe coil along the ceiling between the tanks. Space was quite limited and in one place floor drain pipes which were installed alongside a column created a problem which was solved by making a double offset in the pipe coil lengths around the drain pipes, as shown.

This double offset is sometimes used in wall coils in freezer rooms in packing-house refrigeration, so that the coils can be extended along the walls over the pilasters. In making up the coils an exact drawing of the room is made from which the coil drawing is made. The shop then draws the center line of the offset in chalk on the shop floor and then bends the pipe to suit. The offsets are numbered with paint and the numbers indicated on the blueprint so that the erector can readily identify the parts on the job.

*Engineer, The Vilter Manufacturing Co., Milwaukee, Wis.

Heating·Piping
and Air Conditioning

American Society of Heating and Ventilating Engineers
JOURNAL SECTION

1895

DECEMBER 1934

Table of Contents

The Heat Requirements of Buildings, by J. H. Walker and G. H. Tuttle 515
Some Recent Studies on the Ashes in Coal, by Thos. G. Estep 520
Educational Activities of the St. Louis Chapter, by Paul Sodemann 524
Nominations for 1935 527
Going to Buffalo? 528
Candidates for Membership 534
Candidates Elected 536

The material in this Section is prepared by the Publication Committee of the Society and nothing that appears in it may be reprinted, either wholly or in part, without permission. The use of the Society's name for advertising promotions is never authorized.

OFFICERS AND COUNCIL 1934

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
51 Madison Ave., New York, N. Y.

President ..... C. V. HAYNES
First Vice-President ..... JOHN HOWATT
Second Vice-President ..... G. L. LARSON
Treasurer ..... D. S. BOYDEN
Secretary ..... A. V. HUTCHINSON

COUNCIL

C. V. HAYNES, *Chairman* — JOHN HOWATT, *Vice-Chairman*

One Year

ALBERT BUENGER, F. E. GIESECKE, W. T. JONES, J. F. MCINTIRE, W. E. STARK

Two Years

R. H. CARPENTER, J. D. CASSELL, F. C. MCINTOSH, L. W. MOON

Three Years

M. C. BEMAN, E. H. GURNEY, O. W. OTT, W. A. RUSSELL

COMMITTEES OF THE COUNCIL

Executive: JOHN HOWATT, *Chairman*
J. D. CASSELL, E. H. GURNEY

Finance: R. H. CARPENTER, *Chairman*
F. C. MCINTOSH, J. F. MCINTIRE

Meetings: W. E. STARK, *Chairman*
F. E. GIESECKE, L. W. MOON

Membership: F. C. MCINTOSH, *Chairman*
ALBERT BUENGER, W. A. RUSSELL

ADVISORY COUNCIL

W. T. Jones, *Chairman;* W. H. Carrier, Homer Addams, R. P. Bolton, S. E. Dibble, W. H. Driscoll, H. P. Gant, John F. Hale, L. A. Harding, H. M. Hart, E. Vernon Hill, J. D. Hoffman, S. A. Jellett, D. D. Kimball, S. R. Lewis, Thornton Lewis, J. I. Lyle, J. R. McColl, D. M. Quay, C. L. Riley, F. B. Rowley, F. R. Still and A. C. Willard.

COOPERATING COMMITTEES

A. S. H. V. E. representative on *National Research Council;* Prof. F. E. Giesecke (3 years).

SPECIAL COMMITTEES

Committee on Admission and Advancement: A. J. Offner, *Chairman (two years);* J. G. Eadie *(one year),* and E. N. Sanbern *(three years).*

Publication Committee: W. M. Sawdon, *Chairman;* A. P. Kratz and M. C. Beman.

Committee on Constitution and By-Laws: Thornton Lewis, *Chairman;* W. T. Jones and O. W. Ott.

Guide Publication Committee: W. L. Fleisher, *Chairman;* John Howatt, G. L. Larson, S. R. Lewis, E. N. McDonnell, W. M. Sawdon and J. H. Walker. J. L. Blackshaw, *technical assistant.*

Committee on Ventilation Standards: W. H. Driscoll, *Chairman;* J. J. Aeberly, L. A. Harding, D. D. Kimball, J. R. McColl, C. L. Riley, W. A. Rowe, Perry West and A. C. Willard.

Committee on Code for Testing and Rating Condensation and Vacuum Pumps: John Howatt, *Chairman;* W. H. Driscoll, L. A. Harding and F. J. Linsenmeyer.

Committee on Code for Testing and Rating Convectors: R. N. Trane, *Chairman;* E. H. Beling, R. F. Connell, M. Dillman, W. Ewald, J. H. Holbrook, Hugo Hutzel, A. P. Kratz, M. G. Steele and O. G. Wendel.

NOMINATING COMMITTEE FOR 1934

Chapters	*Representative*	*Alternate*
Cincinnati	J. J. Braun	H. E. Sproull
Cleveland	C. F. Eveleth	F. A. Kitchen
Illinois	J. J. Aeberly	J. J. Hayes
Kansas City	W. A. Russell	E. K. Campbell
Massachusetts	J. F. Tuttle	W. F. Gilling
Michigan	W. G. Boales	Tom Brown
Western Michigan	S. H. Downs	J. H. Van Alsburg
Minnesota	N. D. Adams	C. E. Lewis
New York	H. W. Fiedler	V. J. Cucci
Western New York	D. J. Mahoney	J. J. Yager
Ontario	H. S. Moore	F. E. Ellis
Pacific Northwest	A. L. Pollard	Lincoln Bouillon
Philadelphia	W. R. Eichberg	M. F. Blankin
Pittsburgh	F. C. McIntosh	F. C. Houghten
St. Louis	R. J. Tenkonohy	
Southern California	L. H. Polderman	R. L. Gifford
Wisconsin	E. A. Jones	Ernest Szekely

COMMITTEE ON RESEARCH

JOHN HOWATT, *Chairman*

F. E. GIESECKE, *Vice-Chairman* — DR. A. C. WILLARD, *Technical Adviser* — F. C. HOUGHTEN, *Director*

O. P. HOOD, *Ex-Officio Member*

One Year

D. E. FRENCH, F. E. GIESECKE, L. A. HARDING, G. L. LARSON, A. P. KRATZ

Two Years

ALBERT BUENGER, S. H. DOWNS, H. N. KITCHELL, H. R. LINN, PERRY WEST

Three Years

C. A. BOOTH, E. K. CAMPBELL, JOHN HOWATT, A. J. NESBITT, J. H. WALKER

Executive Committee

JOHN HOWATT, *Chairman*

F. E. GIESECKE, H. R. LINN

Finance Committee

A. J. NESBITT, *Chairman*

N. D. ADAMS, E. C. EVANS, G. L. LARSON, J. H. WALKER

TECHNICAL ADVISORY COMMITTEES - 1934

Air Conditions and Their Relation to Living Comfort: C. P. Yaglou, *Chairman;* J. J. Aeberly, W. L. Fleisher, D. E. French, Dr. R. R. Sayers and Dr. C.-E. A. Winslow.

Air Conditioning in Treatment of Diseases: Dr. E. V. Hill, *Chairman;* N. D. Adams, J. J. Aeberly, Margaret Ingels, H. R. Linn and E. L. Stammer.

Atmospheric Dust and Air Cleaning Devices (Including Dust and Smoke): H. C. Murphy, *Chairman;* J. J. Bloomfield, M. I. Dorfan, Philip Drinker, Dr. Leonard Greenburg, S. R. Lewis, T. W. Pangborn, F. B. Rowley and Games Slayter.

Correlating Thermal Research: R. M. Conner, *Chairman;* D. S. Boyden, J. C. Fitts, H. T. Richardson and Perry West.

Corrosion: J. H. Walker, *Chairman;* H. F. Bain, E. L. Chappell, W. H. Driscoll and R. R. Seeber.

Direct and Indirect Radiation with Gravity Air Circulation: H. F. Hutzel, *Chairman;* A. P. Kratz, H. R. Linn, J. F. McIntire, J. P. Magos, T. A. Novotney, R. N. Trane and G. L. Tuve.

Gas Heating Equipment: W. E. Stark, *Chairman;* Robert Harper, E. A. Jones, Thomson King, J. F. McIntire, E. L. Tornquist and H. L. Whitelaw.

Heat Requirements of Buildings: D. S. Boyden, *Chairman;* P. D. Close, W. H. Driscoll, H. M. Hart, P. E. Holcombe, V. W. Hunter, E. C. Rack, F. B. Rowley, R. J. J. Tennant and J. H. Walker.

Heat Transfer of Finned Tubes with Forced Air Circulation: F. B. Rowley, *Chairman;* H. F. Bain, H. F. Hutzel, W. G. King, A. P. Kratz, E. J. Lindseth, L. P. Saunders, G. L. Tuve and W. E. Stark.

Minimum Temperature and Method of Introduction of Cooling Air in Classrooms: Perry West, *Chairman;* J. D. Cassell, S. R. Lewis, J. R. McColl, A. J. Nesbitt, G. E. Otis and C.-E. A Winslow.

Oil Burning Devices: H. F. Tapp, *Chairman;* Elliott Harrington, F. B. Howell, J. H. McIlvaine, L. E. Seeley and T. H. Smoot.

Pipe and Tubing (Sizes) Carrying Low Pressure Steam or Hot Water: S. R. Lewis, *Chairman;* J. C. Fitts, F. E. Giesecke, H. M. Hart, C. A. Hill, R. R. Seeber and W. K. Simpson.

Refrigeration in Relation to Air Treatment: A. P. Kratz, *Chairman;* E. A. Brandt, John Everetts, Jr., E. D. Milener, K. W. Miller, E. B. Newill, F. G. Sedgwick and J. H. Walker.

Sound in Relation to Heating and Ventilation: V. O. Knudsen, *Chairman;* Carl Ashley, C. A. Booth, F. C. McIntosh, R. F. Norris, J. S. Parkinson, C. H. Randolph, J. P. Reis and G. T. Stanton.

Ventilation of Garages and Bus Terminals: E. K. Campbell, *Chairman;* S. H. Downs, T. M. Dugan, E. C. Evans, F. H. Hecht, H. L. Moore and A. H. Sluss.

OFFICERS OF LOCAL CHAPTERS, 1933-1934

CLEVELAND
Headquarters, Cleveland
Meets: Second Thursday in Month
President, M. F. RATHER
2142 East 19th St.
Secretary, E. J. VERMERE
2125 Wyandotte Ave.

CINCINNATI
Headquarters, Cincinnati, O.
Meets: Second Tuesday in Month
President, H. N. KITCHELL
4528 Circle Ave.
Secretary, E. B. ROYER
6635 Iris Ave.

ILLINOIS
Headquarters, Chicago
Meets: Second Monday in Month
President, R. E. HATTIS
180 N. Michigan Ave.
Secretary, L. S. RIES
5614 Blackstone Ave.

KANSAS CITY
Headquarters, Kansas City, Mo.
Meets: Second Monday in Month
President, L. A. STEPHENSON
409 East 13th St.
Secretary, L. R. CHASE
217 Dwight Bldg.

MASSACHUSETTS
Headquarters, Boston
Meets: Second Monday in Month
President, R. S. FRANKLIN
38 Chauncy St.
Secretary, W. A. MCPHERSON
86 Dwinnell St.
West Roxbury, Mass.

MICHIGAN
Headquarters, Detroit
Meets: First Monday after the 10th of the Month
President, G. D. WINANS
2000 Second Ave.
Secretary, W. F. ARNOLDY
2847 Grand River Ave.

WESTERN MICHIGAN
Headquarters, Grand Rapids
Meets: Second Monday in Month
President, S. H. DOWNS,
211 Creston Ave.,
Kalamazoo, Mich.
Secretary, W. G. SCHLICHTING,
1417 W. Lovell St.
Kalamazoo, Mich.

MINNESOTA
Headquarters, Minneapolis
Meets: Second Monday in Month
President, C. E. LEWIS
829 Second Ave. S.
Secretary, R. E. BACKSTROM
543 So. Snelling Ave., St. Paul, Minn.

NEW YORK
Headquarters, New York
Meets: Third Monday in Month
President, H. W. Fiedler
489 Fifth Ave.
Secretary, T. W. REYNOLDS
100 Pinecrest Drive,
Hastings-on-Hudson, N. Y.

WESTERN NEW YORK
Headquarters, Buffalo
Meets: Second Monday in Month
President, J. J. YAGER
425 Woodbridge Ave.
Secretary, P. S. HEDLEY
Curtiss Bldg.

ONTARIO
Headquarters, Toronto, Can.
Meets: First Monday Every Other Month
President, W. R. BLACKHALL
332 Waverley Rd.
Secretary, H. R. ROTH
1104 Bay St.

PACIFIC NORTHWEST
Headquarters, Seattle, Wash.
Meets: Second Tuesday in Month
President, A. L. POLLARD
601 Electric Bldg.
Secretary, S. D. PETERSON
473 Colman Bldg.

PHILADELPHIA
Headquarters, Philadelphia
Meets: Second Thursday in Month
President, W. P. Culbert
2019 Rittenhouse St.
Secretary, W. R. EICHBERG
4210 Sansom St.

PITTSBURGH
Headquarters, Pittsburgh
Meets: Second Monday in Month
President, P. A. EDWARDS
608 Wabash Bldg.
Secretary, J. L. BLACKSHAW
4800 Forbes St.

ST. LOUIS
Headquarters, St. Louis
Meets: First Wednesday in Month
President, PAUL SODEMANN
4136 Farlin Ave.
Secretary, A. L. WALTERS
7284 Richmond Pl.,
Maplewood, Mo.

SOUTHERN CALIFORNIA
Headquarters, Los Angeles
Meets: Second Tuesday in Month
President, W. H. C. NESS
1323 Channing St.
Secretary, E. H. KENDALL
309 West 12th St.

WISCONSIN
Headquarters, Milwaukee
Meets: Third Monday in Month
President, ERNEST SZEKELY
1817 S. 66th St.
Secretary, G. E. HOCHSTEIN
3000 W. Montana St.

The Heat Requirements of Buildings

By J. H. Walker* and G. H. Tuttle† *(MEMBERS)*

Detroit, Michigan

THIS paper is a contribution to the work of the Technical Advisory Committee on Heat Losses from Buildings. Its purpose is to make available to Society members, certain data relative to building heat losses as reflected in the actual consumption of steam, which have been compiled by district heating companies.

The primary objective of the above-mentioned committee is to study and improve the methods of calculating heat losses for the design of heating systems. The question of the actual heat consumption of buildings is only incidentally related to that objective but is of much practical importance. Its value is in the prediction of heat consumption, rather than in the design of heating equipment, and it is of economic rather than technical significance. The figures which will be given have been obtained under practical conditions and are therefore influenced by uncontrollable factors, such as human habits, and by unmeasurable conditions, such as local vagaries of the weather. Therefore, one should not expect to find extreme refinement or consistency in the data.

Steam Consumption and the Degree-Day

The amount of heat required by a building depends upon the outdoor temperature, if other variables are eliminated. Theoretically, it is proportional to the difference between the outdoor and indoor temperatures. Some years ago the *American Gas Association* determined from experiments in the heating of residences that the gas consumption varied directly as the difference between 65 F and the outside temperature. In other words, on a day when the temperature was 20 deg below 65 F, twice as much gas was consumed as on a day when the temperature was 10 deg below 65 F.

As a result of the information initially provided by the gas industry and later qualified and used in other methods of heating, a unit known as the degree-day was originated and is now used almost universally as a means of estimating and comparing fuel consumptions for different outdoor temperatures. It is defined as a difference of 1 deg between the base inside temperature and the mean[1] outdoor temperature for a day. The number of degree-days in any period is the summation of the differences between the base temperature and the daily mean temperature for that period.

Establishing the Base Temperature

Recently the *National District Heating Association* has studied the metered steam consumption of 163 buildings in 22 different cities, and has published[2] data substantiating the fact that the 65 F base originally chosen by the gas industry is approximately correct. In the *N. D. H. A.* study, the steam consumption of each building by months was divided by the number of days in each month, thus giving the average daily steam consumption by months. The average steam consumption was then plotted against the average monthly temperature, as shown in Fig. 1, and the temperature at which a line drawn through the points crossed the base line indicated the temperature corresponding to zero steam consumption, or the base temperature. The composite results from 163 buildings calculated in this manner are shown in Table 1.

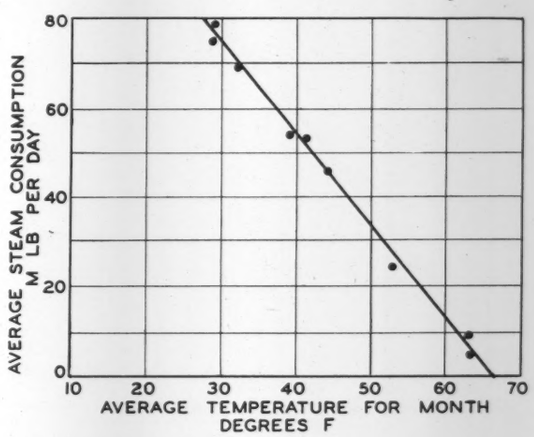


Fig. 1—Method of determining base temperature for degree-day calculations

The grand average of 66.0 F is close to the *A. G. A.* figure of 65 F. It will be noted that the base temperature calculated for hotels, apartments and residences is

Table 1—Base Temperature for the Degree-Day

Type of Building	No. of Bldgs. Analyzed	Temp. corres. to Zero Steam Consumption
Office	60	66.2
Office & Bank	4	65.8
Bank	3	66.2
Office & Telephone Exchange	2	65.5
Office & Stores	6	67.4
Stores	11	64.0
Department Stores	12	64.3
Hotels	7	66.5
Apartments	14	68.8
Residences	8	66.9
Clubs	4	65.5
Lodges	5	64.9
Theatres	3	67.6
Churches	2	65.8
Garage	2	64.8
Auto Sales & Service	4	61.2
Newspaper & Printing	3	67.7
Warehouse & Loft	3	67.7
Office & Loft	2	65.2
Manufacturing	8	65.4
Grand Average for 163 Buildings		66.0

*Superintendent of Central Heating, The Detroit Edison Co.
†Engineer, Central Heating Dept., The Detroit Edison Co.
[1]Average of the daily maximum and minimum temperatures.
[2]Report of Commercial Relations Committee, 1932 Proceedings, *National District Heating Association.*

For presentation at the 41st Annual Meeting of The American Society of Heating and Ventilating Engineers, Buffalo, N. Y. January, 1935.

consistently higher than those for such buildings as garages, auto sales buildings, and manufacturing buildings. This, of course, would be expected in view of the higher inside temperatures carried in the former group; in fact, an even greater difference would be expected. For an all-round average figure, the *A. G. A.* base of 65 F may therefore be safely used, and if greater refinement is desired, the figure for the type of building in question can be taken from Table 1.

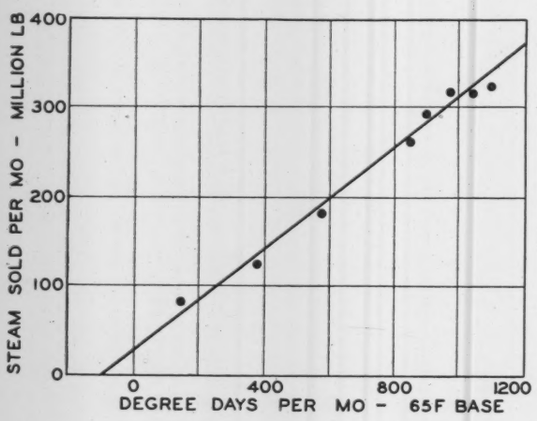


Fig. 2—Relation between steam sold per month by a district heating company and degree-days based on 65 F

A practical application of the use of 65 F base for comparing steam consumptions for heating is shown in Fig. 2. In this illustration the steam sold by a district heating company per month is plotted against the total degree-days for the month. It will be noted that the relationship is fairly constant for all temperatures but that the curve does not intersect zero on the abscissa. However, if a base of 66 F were used, as is established in Table 1, the curve would approach zero on both coordinates.

Mean and Average Temperatures

Since the U. S. Weather Bureau publishes mean daily temperatures rather than average temperatures for the 24 hours, the temperature used in defining the degree-day is the *mean* temperature. Daily variation between mean and average temperatures may be considerable, but when considered over a period of years the difference is quite small. A summation of the total degree-days per month and per year, calculated in each manner, is shown in Table 2.

Table 2—Degree-Days Calculated on a 65 F Base, Using Mean Daily Temperatures and Average Daily Temperatures

Month	Degree-Days based[a] on Mean Temp.	Degree-Days based[a] on Aver. Temp.	Per cent of Total Degree-Days per Month, based on Mean Temp.
Jan.	1199	1189	19.16
Feb.	1008	1043	16.10
March	943	961	15.07
April	576	572	9.21
May	240	226	3.83
June	7	3	0.12
Sept.	55	57	0.88
Oct.	375	384	5.99
Nov.	748	749	11.96
Dec.	1106	1113	17.68
Total	6257	6297	100.00

[a]U. S. Weather Bureau temperature records for Detroit, 1924-1934.

The total number of degree-days per year is approximately 0.6 per cent lower when calculated on the mean temperature basis than when calculated on the average temperature basis, indicating that it makes very little difference which figure is used.

Steam Consumption of Buildings

Table 3 gives the steam consumption per degree-day, expressed in three different ways, for 196 buildings in 14 different classifications. These buildings are divided among 21 different cities in the United States. The steam used for heating the domestic water is included in these figures, but in the case of office buildings, the steam for heating only is also shown. The data are placed on a comparable basis by expressing the steam consumption in terms of pounds per degree-day per thousand square feet of equivalent installed radiator surface, per thousand cubic feet of heated space, and per thousand Btu of calculated heat loss.

The choice of these units of comparison needs some explanation. The use of *heated* space in preference to the gross cubage used by architects is obviously more accurate for this purpose. The architect's cubage includes the outer walls and certain percentages of attic and basement space which are usually unheated. The net heated space is usually about 80 per cent of the gross cubage and can be calculated from the latter if it cannot be measured. At best, the cubical content is somewhat inaccurate as a basis of comparison due to differences in types of construction, exposure, and ratio of exposed area to cubical contents.

The use of radiator surface as the basis of comparison has two objections. One is that the amount of radiator surface in a building is often either excessive or deficient, and figures for steam consumption based on it are therefore likely to be in error. Another reason is that it is difficult to convert fan coil surface into equivalent direct radiator surface with accuracy. On the whole the use of radiator surface as the basis of comparison is the least satisfactory of the three methods.

The authors believe that the calculated heat loss affords the most satisfactory basis of comparison. The figures in the last column of Table 3 were obtained by dividing the steam consumption for the heating season by the degree-days and by the Btu heat loss, in thousands, as calculated for a 70 F difference between inside and outside. Unfortunately, the heat loss figures are not always available and were not available for all classes of buildings given in the table.

It should be noted that the figures in Table 3 are for the heating season only, and include steam for heating domestic water. To calculate the additional steam used only for heating water, in the summer months, the data on hot water given later in this paper can be used.

This method of estimating does not afford absolute accuracy. It gives approximate figures varying perhaps plus or minus 10 to 15 per cent from the true figures.

Monthly Variation in Steam Consumption per Degree-Day.

The data on consumption per degree-day given in Table 3 are calculated for the entire heating season rather than for the individual months. The figure as

Table 3—Steam Consumption for Various Classes of Buildings[b] (Heating Season Only)

Building Classification	No. of Bldgs. Listed	Steam Consumption—Pounds per Degree-Day—65 F basis[c]: Per M cubic feet of Heated Space	Per M Square feet of Radiator[d] Surface	Per M Btu per Hour of Heat Loss[c]
Apartments	16	1.78	97.5	0.359
Hotels	10	1.46	80.6	0.371
Residences	12	1.32	64.2	——
Printing	7	1.26	105.5	——
Clubs & Lodges	10	0.96	77.0	——
Retail Stores	18	0.90	80.6	0.268
Theatres	6	0.90	75.0	0.498
Loft & Mfg.	16	0.89	72.3	0.283
Banks	7	0.88	45.2	——
Auto Sales & Service	8	0.83	62.2	——
Churches	6	0.58	49.4	——
Dept. Stores	14	0.57	60.7	0.238
Garages (Storage)[f]	6	0.42	72.3	——
Offices (Total)	35	1.09	70.0	0.283
Offices (Heating only)	35	0.975	65.4	0.256

[b]Includes steam for heating domestic water for heating season only.

[c]Heat loss calculated for maximum design condition (in most cases 70 F inside, zero outside).

[d]Equivalent radiator surface.

[e]The figures are a numerical—not a weighted—average for the several buildings in each class.

[f]Based on zero consumption at 55 F.

given, then, is the average consumption figure for the entire year. The consumption factor per degree-day is not always constant throughout the heating season. In

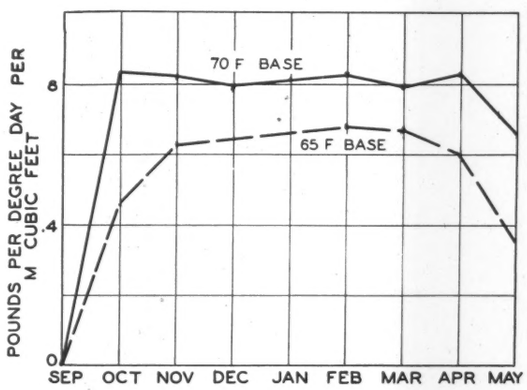


Fig. 3—Monthly variation in steam consumption per degree-day for St. Louis buildings

St. Louis, Mo., for example, the steam consumptions of 140 buildings were studied for three consecutive years. The monthly consumption factors per degree-day per thousand cubic feet of heated space are shown in Fig. 3[3]. It would appear from this study that the steam consumption per degree-day for heating only is lower in the spring and fall months than during the winter months. However since September and May represent less than 5 per cent of the entire heating season, the error would be slight if the same consumption factor were used for these months as is used for the remainder of the year.

Table 4—Comparison of Steam Consumption Before and After Installing Temperature Control Equipment

Type of Control	No. of Bldgs.	Steam for Heating Pounds per Degree-Day: Before	After	Saving Per Cent
1. Sub-atmospheric Pressure System	5	1720	1450	15.7
2. Orifice System Controlled by an Outdoor Thermostat	2	2039	1600	21.6
3. Orifice System Controlled by Group of Outdoor Thermostats	1	4580	4255	12.2
4. Orifice System—Manual Control	3	7930	6750	14.9
5. Orifice System—Electric Zone Control	2	4110	4025	2.1
6. Intermittent Control—Electric Timer	5	1340	1200	10.4
7. Intermittent Control Actuated by Outdoor and Radiator Temperatures	14	772	623	19.3
8. Central Thermostat	19	776	585	24.6

Effect of Temperature Control Devices Upon Steam Consumption

When temperature control equipment is installed in existing buildings, it is usually for the purpose of reducing the steam consumption. Table 4 gives the steam consumption in pounds per degree-day for 51 buildings before and after installing temperature control equipment. The reduction in steam consumption expressed as a per cent saving is given in the last column.

The results in Table 4 should be interpreted with caution. The data by no means constitute a comparative test of control equipment, because in many cases the reduction in steam consumption following the installation of control equipment cannot be credited entirely to the new equipment. Very large percentages of saving are always open to question as it is likely that in most cases the control equipment is only one of the several factors which have combined to produce the saving. The results, however, indicate in a general way what can be accomplished with control equipment coupled with intelligent handling of a heating system.

Maximum Demands and Load Factors

In one form of district heating rates, a portion of the charge is based upon the maximum demand of the building. The maximum demand may be measured in several different ways. It may be taken as the instantaneous peak or as the rate of use during any specified interval. One method is to take the average of the three highest hours during the winter. These figures are available for a number of buildings in Detroit, as shown in Table 5.

These maximum demands were measured by an attachment on the condensation meter and therefore represent the amounts of condensation passed through the meter in the highest hours, rather than the true rate at which steam is supplied. There might be slight differences in these two quantities due to time lag and to storage of

Table 5—Building Load Factors and Demands of Some Detroit Buildings

Building Classification	Load Factor	Pounds of Demand per Hour per Square Foot of Equivalent Installed Radiator Surface
Clubs and Lodges	0.318	0.184
Hotels	0.316	0.207
Printing	0.287	0.217
Offices	0.263	0.209
Apartments	0.255	0.225
Retail Stores	0.238	0.182
Auto Sales and Service	0.223	0.248
Banks	0.203	0.158
Churches	0.158	0.152
Department Stores	0.138	0.145
Theatres	0.126	0.151

[3]R. M. McQuitty, as reported in the *N. D. H. A. Proceedings* of 1934, by the Commercial Relations Committee.

condensate in the system, but wherever this has been investigated it has been found to be negligible.

The load factor of a building is the ratio of the average load to the maximum load and is an index of the utilization habits. Thus, in Table 5, the theatres, operating for short hours, have a load factor of 0.126 as compared with the figure of 0.318 for clubs and lodges.

The maximum steam demand for heating of a building does not necessarily occur on a day of minimum temperature. There are apparently other factors, such as direction and velocity of wind, sunshine, and time of year, which affect the steam consumption of buildings. This peculiarity of peak demands is illustrated in Figs. 4 and 5. In Fig. 4 are three typical daily load curves for a district heating system which supplies steam to approximately 1300 buildings. They show the steam delivered to the street mains by the boiler plants. Curve 1 is the system load for a cold day in mid-winter; Curve 2 is a mild day in the fall; and Curve 3 is for a mild day in mid-winter. The two days on which loads for Curves 2 and 3 were established were practically identical as far as apparent heating requirements were concerned. It is true that there was a larger percentage of sunshine on the October day; however, the peak output which occurs between 8:00 and 9:00 a. m. is very little affected by the sunshine during the day. The peak output on the January day was 25 percent higher, and the total output for the day was 42 per cent higher, in spite of the fact that the 6:00 a. m. temperatures were only 1 deg different and the average temperatures for the two days were the same. The explanation probably is that those in charge of the operation of some building heating systems are inclined to delay in turning on heat in the early fall days. It is also probable that people can tolerate a cool day in the fall without heat more readily than they can in mid-winter.

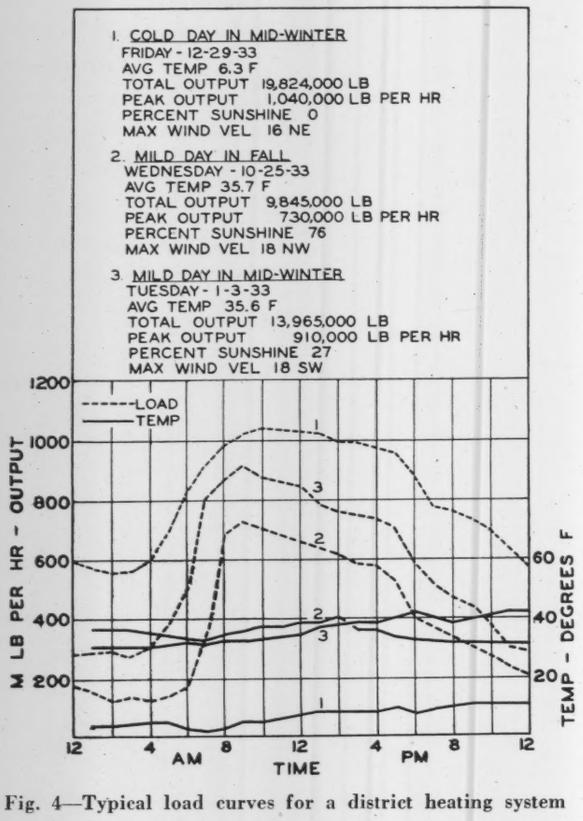


Fig. 4—Typical load curves for a district heating system

Curve 1 is for a cold day in mid-winter. On this particular day, when the average temperature was approximately 30 deg lower than the mild day in January, the peak output was only 14 per cent higher and the total output for the day 42 per cent higher. It is evident from a study of these curves that outside temperature is by no means the sole factor in determining heating requirements, particularly the maximum demand.

The points plotted in Fig. 5 are maximum steam output figures of a district heating system with given 5:00 a. m. temperatures. The days of the week are denoted on the curve by code. One might assume that office buildings which are unheated on Sundays would require more heat on Monday than on any other day of the week having a corresponding temperature. If this were the case, there would be a predominance of Monday points at the top of the group. This, however, is not the case. Here again the data prove the fallacy in the belief that there is a definite relationship between peak steam demands and outdoor temperatures. It will be noted, however, that the relation between peak demand and outdoor temperature is much more constant in the lower than in the upper ranges of temperature. The curve which is located so as to include all the points is used to predict the boiler capacity which must be held available for the day's load.

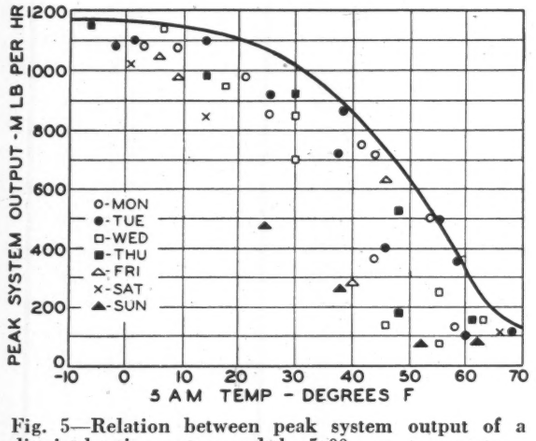


Fig. 5—Relation between peak system output of a district heating system and the 5:00 a. m. temperature. All data taken between January 1st and June 1st

A careful study has been made to correlate the several variables which might control these daily peaks in the hope of determining a consistent relationship which would make it possible to predict the boiler requirements. Temperature, sunshine, wind velocity, day of the week and season of the year have all been considered, but attempts at correlating them have been unsuccessful. There are probably certain psychological or physiological factors which are influential and which cannot as yet be identified.

Table 6—Hot Water Used by Various Types of Buildings

City	Bldg. Volume[g] Cu Ft	Hot Water Used, lb per Day	Maximum Hot Water Demand, lb per Hour	Lb Hot Water per Day per M Cu Ft Bldg. Volume[g]	Maximum Hot Water Demand Lb per Hour per M Cu Ft Bldg. Volume[g]	Notes
			Office Buildings			
Baltimore	5,500,000	33,600	3,375	6.1	0.613	Utility offices; 3 beauty shops, 6 doctors' offices; 3 shower baths; hot water in every room.
Baltimore	2,790,000	26,800	2,500	9.6	0.896	24-hour restaurant open 6 days per week, 300 meals per day; 1 small soda fountain and lunch counter.
Baltimore	795,000	2,100	750	2.6	0.944	Bank on 1st floor.
Baltimore	4,361,286	46,000	4,310	10.5	0.989	1—24-hour restaurant, 400 meals per day; 1—16-hour restaurant, 200 meals per day; 1 barber shop.
Detroit	3,480,000	38,740	3,360	11.1	0.965	Small restaurant on 1st floor; 1 barber shop.
Detroit	1,776,000	29,035	1,690	16.4	0.952	Drug store with soda fountain; 3 beauty shops; 1 barber shop.
St. Louis	4,336,095	67,910	7,000	15.7	1.616	116,000 lb hot water used on maximum day.
St. Louis	1,617,079	7,880	1,200	4.9	0.743	12,000 lb hot water used on maximum day.
St. Louis	2,417,385	32,700	4,920	13.5	2.040	45,000 lb hot water used on maximum day.
St. Louis	3,196,497	30,265	2,800	9.6	0.878	56,000 lb hot water used on maximum day.
Portland	531,000	14,500	1,265	27.3	2.380	Stores on 1st floor.
Portland	1,462,000	13,770	1,015	9.4	0.694	
Average				11.4	1.14	
			Hotels			
Akron	7,000,000	292,200	....	41.8	....	450 rooms, kitchen, laundry, and barber shop.
Detroit	940,000	26,110	2,500	27.8	2.66	234 rooms, 80 baths, restaurant, barber shop, soda fountain, 106 guests.
St. Louis	1,253,193	145,575	14,080	116.0	11.21	345 rooms, 198,000 lb hot water on maximum day.
Portland	2,175,000	137,985	15,775	63.5	7.25	297 rooms, laundry, dining room, and Turkish bath.
Portland	1,163,000	51,105	4,800	44.0	4.13	Dining room and coffee shop.
Portland	212,000	12,235	1,100	57.7	5.19	Apartment hotel.
Average				58.5	6.09	
			Apartment Building			
Portland	635,000	40,210	3,605	63.3	5.68	
			Women's Club Building			
Detroit	901,950	70,365	4,180	78.0	4.63	210 sleeping rooms, dining room, and laundry.
			Restaurant			
Detroit	.....	34,680	2,310	....	....	24-hour restaurant; seating capacity, 128; meals per day, 2,500.

[g]Heated Space.

Hot Water Requirements of Various Classes of Buildings

There is very little published information on the actual amount of hot water used by various types of buildings. In order to determine the proper size of water-heating economizer for a building, it is necessary to know the amount of hot water used and also the rate at which it is used at different times of the day. These figures are also needed for determining water heater sizes and estimating steam demands caused by water heating. To obtain this information,[4] water meters were installed to meter the cold water supplied to water heaters in 20 buildings in 5 cities. The results are given in Table 6.

The average hot water requirement of the twelve office buildings was 11.4 lb per day per thousand cubic feet of building volume; however, in one building in Portland, Ore., it was as high as 27.3 lb per day per thousand cubic feet.

The average amount of hot water used by hotels was 58.5 lb per day per thousand cubic feet, but in one case the figure was as high as 116.0.

The last column of Table 6 gives the maximum demand for hot water in terms of building volume. These figures should be used in determining water heater sizes and expected steam demand. In using the figures given in the table to determine steam demands and consumption, it can be safely assumed that one pound of steam will supply 10 lb of hot water. To convert Table 6 to read pounds of steam instead of pounds of water, the water constant given may be divided by 10.

[4]1932 *Proceedings* of the *N. D. H. A.*

Summary

The paper gives the heat consumption of a large number of buildings on a degree-day basis and recommends, as a unit for comparison, the heat consumption per degree-day per thousand Btu of calculated heat loss.

The maximum demands and load factors are given for different kinds of buildings. That the maximum demand and heat consumption are affected by other variables than temperature alone is demonstrated by typical load curves from a district heating system.

Data on the hot water consumption of various kinds of buildings are included.

Directory of Engineering Societies and Associations

The need for a directory of national, state and local engineering and affiliated technical societies and associations has been evidenced and this work is now being undertaken by the *American Engineering Council, Engineering Foundation* and the *Engineers' Council for Professional Development.*

It is proposed to issue this directory by January 1, 1935 and the information regarding each society will include name and address, scope, date and place of meetings, number of members, qualifications for membership and dues rate, publications, principal activities, and awards.

Some Recent Studies on the Ashes in Coal

By **Thos. G. Estep† Pittsburgh, Pa.** ***(NON-MEMBER)***

DURING the last few years there has been a very rapid development in the art of burning coal for steam generation purposes, particularly in large central generating stations. During this period underfeed stokers and powdered coal systems have been brought to such a high state of perfection that it is now possible to burn efficiently almost any grade of coal at very high rates of combustion. It is very significant that this development has followed along two lines; *first,* the design of furnaces which would permit of high rates of heat release without destruction of the furnace walls, and, *second,* the design of the mechanical part of the coal burning equipment so that the ash in the coal could be disposed of continuously with little loss and that clinker trouble would be reduced to a minimum. The second part of this development required a knowledge of the composition of the ash in coal, the ash fusion temperature, the fluidity of the molten ash, the mechanism of clinker formation and, most important of all, the correlation of these factors so that if they are known, the behavior of the coal in burning can be closely predicted and suitable equipment designed.

There are so many factors entering into the subject of the behavior of ash in coal during the combustion process that field tests under actual operating conditions are of little value, because it is impossible to establish a given set of conditions and maintain them over a long enough period of time to secure accurate information. The combustion engineer, therefore, turned to the laboratory for information because in laboratory tests certain of the factors may be held constant while others are allowed to vary, and in this manner the importance of each factor may be determined and its relationship to the others established. The leaders in these laboratory studies have been the U. S. Bureau of Mines, the large coal consuming public utilities and research laboratories located in several of the engineering colleges. Valuable work has also been done in foreign countries, notably in Canada, England, and Germany.

It is the purpose of this paper to review briefly the results of these various investigations and to point out how this information may be applied advantageously to the heating industry. So far, the designers of domestic and semi-public building heating systems have looked upon ash in coal as a nuisance to be put up with and have been more concerned with its quantity rather than with its behavior, but, with the advent of small stokers and other modern devices for burning coal, a knowledge of ash and the part it plays in combustion becomes of increasing importance.

†Professor of Mech. Engrg., Carnegie Institute of Technology.

For presentation at the 41st Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Buffalo, N. Y., January, 1935.

Composition of Ash in Coal

The ash in coal is usually divided into two parts, the inherent and the extraneous. The inherent ash is that incident to the plant life which went into the formation of the coal. It very rarely exceeds 4 per cent and varies within very narrow limits. The extraneous ash is the earthy material mixed with the coal forming materials during periods of inundation and during the movements of the earth's crust. This ash varies within wide limits and no attempt will be made to establish these limits. For certain studies it is desirable to attempt to separate the ash into these two divisions, but the engineer is usually interested only in the average composition of the total ash.

Coal ashes have an exceedingly complex composition made up of many constituents. The ash analysis shows only the simple chemical compounds, without indicating how these compounds may be combined in the coal. The following compounds are usually reported in an ash analysis: SiO_2, Al_2O_3, Fe_2O_3, CaO, TiO_2, MgO, P_2O_5, Na_2O, K_2O and SO_3. Usually P_2O_5 is not determined separately but is included in the Al_2O_3 and the alkalies Na_2O and K_2O are not separated.

The silicon will probably be in the form of silicates, sand and quartz; the aluminum as clay, usually combined with silicon; the iron as pyrite, marcasite, siderite, and ferrous silicates; the magnesium as carbonates and silicates; the calcium as sulphates, carbonates and silicates; the sodium and potassium as silicates, carbonates and chlorides; the inorganic sulphur as pyrite, marcasite and the phosphorus as phosphate. During the burning of the coal certain changes take place in the ash which will not be discussed here.

The various compounds reported in an ash analysis vary within wide limits as indicated by the accompanying table:

SiO_2	30 to 60 per cent	CaO	2 to 20 per cent
Al_2O_3	10 to 40 per cent	MgO	0 to 4 per cent
Fe_2O_3	5 to 30 per cent	SO_3	0 to 9 per cent
TiO_2	0 to 3 per cent	Alkalies	1 to 4 per cent

It is the great variation in ash composition which causes the wide variation in the ash fusion temperature and its behavior when the coal is burned.

Ash Fusion Temperature

The technique of ash fusion temperature determinations is fully outlined in bulletins of the *American Society for Testing Materials* and need not be discussed here. It should be mentioned, however, that the fusion temperature is always determined in a reducing atmosphere in the furnace and, as will be shown later, this

gives the lowest fusion temperature obtainable with a given ash.

The ash fusion temperatures of United States coals varies from about 2,000 to 3,100 F.

Clinker Formation

It is usually stated that coals having ash fusion temperatures below 2,400 F are clinkering coals and above this figure they are non-clinkering. This is purely an arbitrary dividing line and has little bearing on the question as to whether or not a coal will produce clinker

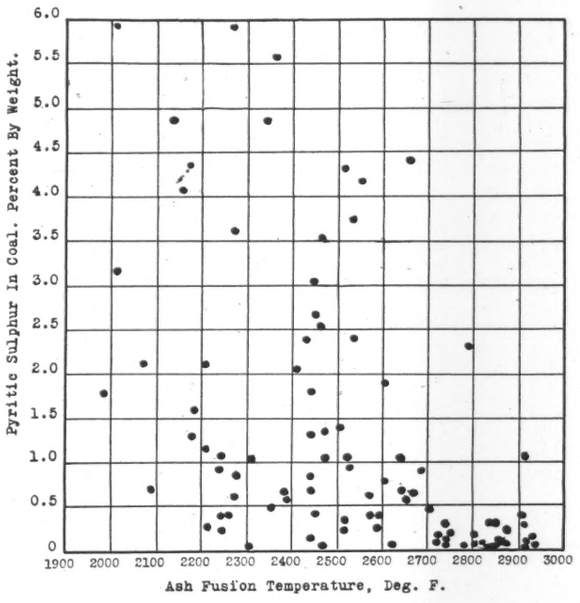


Fig. 1—Pyritic sulphur and ash fusion temperature

when burned. The ash fusion temperature is only one of a great many factors entering into clinker formation and it is impossible to make a prediction of how the ash will behave based on this one factor alone.

In Bureau of Mines Bulletin 209 are given the ash fusion temperatures of over 2,100 United States coals. It is interesting to note that 53 per cent of these temperatures lie below 2,400 F. This means that a majority of the coals in use would be classed as clinkering coals if the above arbitrary division were used.

An examination of the ash from a coal furnace will show that, although there may be no clinkers, nearly all of the ash was fused. The only exceptions to this are in cases where the ash was very highly refractory or where the combustion rate was very low. In other words, the fuel bed temperature is nearly always high enough to fuse the ash. The ash gradually gravitates to the bottom of the fuel bed and there it is acted upon by two opposed conditions, the radiation of heat downward from the burning fuel bed and the cooling effect of the combustion air coming up through the grate. If the cooling effect of the air is not sufficient to cool the ash below its fusion temperature, then clinker will result. Thus it can be seen that, while the possibility of clinker formation is reduced by using a coal of a high ash fusion temperature, it is possible, by using proper precautions, to burn coals with low ash fusion temperatures without clinker. There is no better way known to produce clinker than to close the ash pit doors with a good fire going in the furnace. This shuts off the flow of air through the grate and its cooling effect on the ash is lost. A heavy fire will produce the same result, due to the increased resistance to air flow. If the fire is stirred deeply with the firing tools the ash will be brought up from the grate into the hot fuel bed, where it will be fused again and clinkers will form.

Sulphur in Coal

There is a great deal of misinformation concerning the cause of clinkering. For example, many believe that a coal which is high in total sulphur will cause considerable clinker formation. This idea is wrong. Sulphur appears in coal in two forms, organic and inorganic, and the relative proportions of these two forms vary within wide limits. Organic sulphur will burn to sulphur dioxide or trioxide and has no effect whatsoever on the behavior of the ash. The only bad effects from organic sulpur are atmospheric pollution and the corrosive action of sulphur dioxide when combined with water.

The inorganic sulphur is usually in the form of iron pyrite (FeS_2). The late Dr. Parr of the University of Illinois believed that this compound first breaks up into ferrous sulphide (FeS) and free sulphur. The ferrous sulphide fuses at a temperature of 2,190 F and may act as a binder for the slate and other impurities and thus produce clinker. There is no conclusive proof, however, that this action does take place in a boiler furnace.

It has also been shown that if pyrite is burned in a highly oxidizing atmosphere, that is, with a large excess of oxygen, the iron will be oxidized to ferric oxide (Fe_2O_3) and this will combine with the silica in the ash to form high fusion temperature compounds. If the atmosphere is slightly reducing, that is, a deficiency of oxygen, the iron becomes ferrous oxide (FeO), which will combine with silica to form readily fusible silicates. If the atmosphere is highly reducing, metallic iron will result from the pyrite. Thus there are three possibilities from the pyrite, depending upon the furnace atmosphere. Two of these possibilities will result in raising the fusion temperature and one in lowering it. In a boiler furnace it is possible to have all three types of atmospheres at the same time. If the fuel bed does not offer uniform resistance to the draft, at some places there will be an excess of oxygen and in others a deficiency.

There is no doubt but that iron pyrite plays some part in clinker formation, but it is only one of many factors. At the Second International Conference on Bituminous Coal the author presented a paper on the subject of clinkering. Included in this paper was a diagram of pyritic sulphur plotted against ash fusion temperatures, showing that no relationship existed between the two. At the time this diagram was prepared, not many points were available. Since that time more information has been secured and the diagram is repeated here (Fig. 1) with more than 50 points added. These additional points only go to confirm the original statement that no definite relationship exists between pyritic sulphur and ash fusion temperature.

However, another diagram has been prepared (Fig. 2) which does indicate a little more definitely the part played by iron in coal ash when combined with silica and alumina. The heavy line across the diagram near the top shows the melting point of mixtures, in various proportions, of pure silica and alumina. The ratio of silica to alumina of 34 coal ashes has been plotted along with the ash fusion temperature on this same system of coordinates. The iron content of these ashes was also known and an attempt has been made to draw contours of equal iron content as shown. There are not nearly enough points available to determine the exact position of these contours, but the general direction, at least, can be determined. There are always some points which fall outside of any general trend because of the predominance of some other ash constituent such as calcium or magnesium. For example, J. W. Greig, in the *American Journal of Science,* 1927, states that for mixtures of silica with lime or magnesia, only a very small percentage of alumina is necessary to produce a marked lowering of the fusion temperature. As a direct cause of clinkering the case against pyritic sulphur is not complete, and much more information is needed before definite conclusions can be drawn.

An investigation is in progress at the Carnegie Institute of Technology where synthetic coal ashes are being made up from pure chemicals and the fusion temperature compared with that of an identical natural ash. Not enough work has been done yet to draw any conclusions, but if it is found that synthetic ash has approximately the same characteristics as natural ash, then it will be possible to determine the effect of each ash constituent by varying the quantity of one constituent while the others are held constant.

Quantity of Ash

The impression prevails among many coal consumers that coals which are high in ash are more likely to produce clinker than those with a low ash content. The quantity of ash has no relationship whatsoever with clinker formation. For example, in some of the lumber industries where wood waste is used for fuel, much difficulty is experienced from clinker, yet the ash content is probably less than one per cent by weight. Anthracite culm is used as a steam fuel without difficulty and its ash content may be as high as 50 to 60 per cent.

Strange as it may seem, considerable difficulty is experienced in burning petroleum coke on a grate, due to the fact that it has practically no ash, the only residue being the sand in the original oil. Without the protection of the layer of ash the grate bars burn out rapidly and maintenance costs are high.

It is true that the consumer pays just as much for the ash as is paid for the coal substance and in addition usually must pay for its disposal, but the ash is not a total loss because a moderate amount will reduce maintenance costs and enable the user to carry a slow fire during moderate weather without a large amount of excess air.

The consumer should distinguish between the weight and volume of ash in coal. Frequently the complaint is heard that nearly as much ash is carried out as coal is fired. Such a statement is not necessarily a great exaggeration because the ash in some coals swells on fusing to three or four times its original volume. Some of the Clearfield cannel coals are of this type, yet the ash by weight is not excessive.

If a consumer believes that the ash is too high, judging by the volume which must be removed, he should determine the percentage by weight before making a complaint.

Effect of Mixing Coals on the Ash Fusion Temperature of the Mixture

A very extensive study was made at the Carnegie Institute of Technology of the effect of mixing coals on the ash fusion temperature of the mixture and the results published in Bulletin 62, *Mining and Metallurgical Investigations.*

Fourteen coals from the Western Pennsylvania district having a wide variation in ash analyses and fusion temperatures were used in this study. Only two different coals were mixed at a time and usually two proportions were made for each mixture.

The ash fusion temperature of each coal was determined separately and then the ashes from two of these coals were mixed in the proportions of 60 per cent of one and 40 per cent of the other by weight and then the proportions reversed. The fusion temperatures of the two mixtures were then determined and compared with the calculated weighted average for these two ashes. To make this clear, an example will be given. Assume a mixture of coals *A* and *B*. These two coals had ash

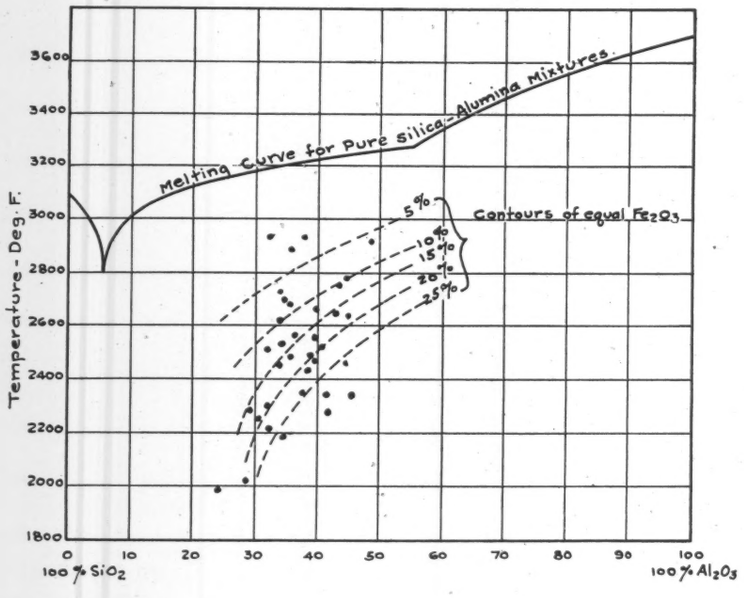


Fig. 2—The system SiO_2-Al_2O_3. Fusion temperatures of natural coal ash compared with those of silica-alumina mixtures

fusion temperatures of 2,285 and 2,665 F and ash contents of 10.2 and 7.4 per cent, respectively. A simple calculation shows that if 52.3 per cent of coal *A* is mixed with 47.7 per cent of coal *B*, the resulting ash will be composed of 60 per cent from coal *A* and 40 per cent from coal *B*. If the ashes from the two coals are to have no action on each other, then the fusion temperature of this mixture should be the calculated mean of the two. Thus,

For coal *A*, $0.60 \times 2{,}285 = 1{,}371$
For coal *B*, $0.40 \times 2{,}665 = 1{,}066$
Calculated mean = 2,437 F

The actual determined value was 2,495 and the result of mixing these two ashes was a slight increase in the fusion temperature.

Using the 14 coals, there were 71 different combinations of two coals each reported, and four different types of results were noted, as shown in Fig. 3. Nine combinations showed an increase in fusion temperature, 19 no change, 43 a decrease, nine of which were of the eutectic type.

Thus about 60 per cent of the mixtures resulted in a lowering of the ash fusion temperatures; in some cases as much as 400 F, while the increase in the other 40 per cent was small, usually less than 100 F. There is no way of predicting the result of mixing two or more coals unless the ash analyses are known.

Ash Fusion Temperatures and Domestic Stokers

The desire for greater convenience and smokeless combustion in domestic heating has led to a very rapid development of the small stoker for bituminous coals. Nearly all of these stokers use the underfeed principle and depend upon the removal of the ash in the form of clinker. With this system of ash removal consideration must be given to the ash fusion temperature. Generally a domestic stoker will operate intermittently at very low rates of combustion and if the ash is of a highly refractory nature it will not fuse and some difficulty will be experienced in ash removal. It may be necessary in some cases to add some extraneous material to the coal in order to reduce the fusion temperature so that clinker will form readily and permit of easy removal. Just what material may be added to secure the desired result is not definitely known. Some very interesting work has been done at the Bureau of Mines in mixing fluxing agents with coal ash slag, the most promising fluxes being lime and ferric oxide, but how this could be applied to domestic fuels has not been worked out at present. A very important fact was brought out in the above investigation that there was a wide variation in the fluidity of molten slag. Two slags may have the same softening temperature, but one may be very fluid while the other may be very viscous. Fluidity or viscosity is an important factor in clinker formation, but unfortunately little experimental work has been done along this line of investigation.

Effect of Weathering on Coal

Weathering of coal is the term applied to the slow changes which take place in coal during storage. Coal may be stored in the open where it is subject to the atmospheric elements of rain and snow or it may be stored in a sheltered place, such as the cellar of a domestic consumer.

When stored in the open, the pyrite will be acted upon by air and water, forming sulphuric acid and ferric sulphate. The sulphuric acid will combine with some of the lime and magesium in the ash to form sulphates. Some of the iron may go to oxides and be washed away.

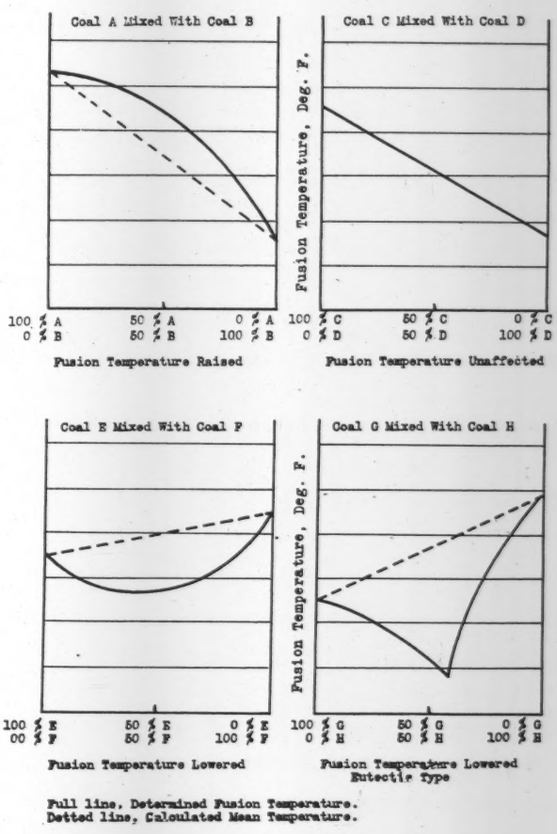


Fig. 3—Effect of mixing coals on the ash fusion temperature of mixture

Weathering in the open should, therefore, raise the ash fusion temperature, and the very limited test data on this subject indicate that this is true, but more information is needed. Weathering in a sheltered place probably has little or no effect on the ash fusion temperature and very little effect on the coal itself unless spontaneous combustion takes place.

The Domestic Furnace as an Incinerator

It is a prevalent custom in communities where there is no rubbish and garbage collection to use the heating plant furnace for the disposal of this refuse during the heating season. A limited study was made of this problem by Langtry and Kohout and reported in the *Proceedings of the Second International Conference on Bituminous Coal.* They found that general garbage ash had a fusion temperature of less than 2,000 F but, if the glass and metal were removed, the fusion temperature was raised several hundred degrees. Various kinds of incinerator ash were then mixed with coal ash and in all cases resulted in a marked lowering of the fusion

temperature, even when added in small quantities. This investigation would seem to indicate that if trouble from clinker is experienced when burning a pure coal, it will be increased if the domestic furnace is used as an incinerator, particularly if the bottles and tin cans are not first removed. Burning of household refuse might be a partial solution to the problem of producing clinker in stoker fired domestic furnaces where clinker is desirable.

Conclusions

The subject of the ashes in coal is being studied intensively today in many laboratories. Much information has been secured, but much more remains to be done before it will be possible to determine by a coal and ash analysis just what may be expected during a given combustion process.

Some idea of the difficulties of the problem can be had by keeping in mind the complex composition of the ash itself, the variation of the amount and composition in the natural coal bed, the variation brought about by mining and preparation methods and finally by the great variation in the uses of coal and the methods of burning it.

In the final analysis the trouble experienced from coal ash will depend almost entirely on the system and method employed in burning it. Large power station operators have demonstrated their ability to burn almost all coals without difficulty and with high efficiency by studying the peculiarities of each coal and making changes in their method of managing the fires so as to avoid trouble.

To expect a high degree of skill in combustion from a domestic consumer is asking too much, and it is also impossible for a coal yard to send a skilled fireman along with every load of coal. It is believed, however, that a great deal may be accomplished by the dealer supplying each customer with printed instructions which apply to the particular coal furnished. Much of the printed matter read by the domestic consumer is of a general nature and it has its value, but he wants to know particularly how to burn the coal in his bin to the best advantage.

Once the consumer has found a coal which is suited to his equipment and which meets his needs with the minimum amount of trouble, he should try to secure this coal from season to season instead of shopping around each year and buying on a price per ton basis only. In a domestic heating plant convenience and comfort are the two most important factors and they cannot be evaluated in dollars and cents. The cheapest coal per ton is not often the cheapest coal to use.

The author believes that in the distant future gas will be the universal domestic fuel and the gas will, of necessity, be made from coal. With the proper appliances gas can be burned efficiently without skill and all of the knowledge gained from the present and future researches on coal and its ash can be applied by technically trained men to the gas making process. The domestic consumer can never be made a fuel technologist.

Educational Activities of the St. Louis Chapter

By **Paul Sodemann*** ***(MEMBER)***

IN the early days of air conditioning, the need of skillful mechanics for operation and maintenance was very great. With the public acceptance of comfort conditioning it has continued to grow. Firms making the first installation often found it necessary to furnish the operator from within their own personnel, because the ultimate success of any heating, ventilating or air conditioning installation depends as much upon skillful operation and maintenance, as upon the proper design and installation. A fact generally admitted is that a skillful operator often gets better results out of poorly designed and installed equipment than an unskilled operator sometimes secures from the finest installation. This industry for some time has been so thoroughly standardized that the internal design of the various units offered have reached a high state of perfection. Most manufacturers have testing and research laboratories where their products are subject to exacting tests and those not so equipped have had the seasoning effect of several years of actual operation to remove all inherent defect.

Usually there is also sufficient ability available to properly co-ordinate the various standard products into a finished design capable of high efficiency if properly operated and maintained. In this respect the construction branch of the industry has advanced far beyond the operating and maintenance division.

It appears therefore that there is a definite and perhaps neglected need for training men who are skilled in the operation and maintenance of heating, ventilating and air conditioning plants. The obligation of doing this can rest only with those who possess the knowledge and ability to convey the necessary information to these men in understandable terms. Generally speaking, it is not the college graduate who is found firing the boiler or operating the plant, but rather a man who has had only a high school training or less. This fact perhaps accounts in some degree for the gap that seems to exist between members of the professional branch of the industry who design the apparatus and those who operate and maintain the same equipment.

Much good has been done in supplying these men with the information they require through the medium of books such as THE A. S. H. V. E. GUIDE and the publication of catalogs and data books by the various manufacturers of air conditioning apparatus, but, lacking the basic training in mathematics and physics, the average man engaged in this line of work has felt the need of personal contact to explain to him those things he did not understand. The sales engineers have contributed much in this direction, but the most effective method yet

*Pres., St. Louis Chapter, A. S. H. V. E.

devised for this purpose in this industry and others seems to be the trade school.

The David Ranken, Jr., School of Mechanical Trades of St. Louis, Mo., is one of these schools. It is a philanthropic institution founded and liberally endowed by the late David Ranken, Jr., of St. Louis.

The school exists for the purpose of training and fitting men and boys for mechanical or manual trades and occupations. Mr. Ranken in making the bequest stipulated that the instruction given must always be practical.

Modern industrial methods preclude the giving of such instruction in commercial shops and it is only recently that schools for salesmen have been conducted by various manufacturers. Other attempts have been made to reach men engaged in operation and maintenance work by placing them in the production organization of a factory for short periods but employees and workmen alike have come to realize that a properly conducted trade school can and does offer men and boys a better preparation and grounding in the fundamentals they need than can be gained by working at the trade commercially, or in any other known manner.

The Ranken School does not prepare for college or for the engineering profession. Instructions now offered in the day school cover automobile repair, carpentry, electricity, machine shop practice, painting, plumbing, power plant operation and maintenance, radio and refrigeration, including in each drafting, English composition, mathematics and science. In the evening classes instruction is offered in these and in other subjects according to the demand. The students pay only a nominal fee to assure their sincere interest, this fee covering but a small part of the cost of operating the school. The school is supported almost entirely by the income of Mr. Ranken's estate.

Since the school was founded by Mr. Ranken the endowment has been augmented from time to time by other bequests, one of which was made by Eli Larkin, who at his death in 1920 left a considerable part of his fortune to the establishment of the Larkin Foundation. Under the terms of his will the income from these funds is to be used:

1. For instruction in power plant operation, in refrigeration, in heating and ventilating, and cognate and similar subjects.

2. The establishment and maintenance of lecture courses in technical and other subjects suited to the need and welfare of boys and men either engaged or preparing to engage in work of a mechanical nature and manual trades.

In 1929, O. H. Turner, superintendent of the Ranken School, approached the St. Louis Chapter of the Society requesting that a committee be appointed to confer with the officials of the school in an effort to provide means of complying with the provisions of Mr. Larkin's bequest in connection with heating and ventilating. Pres. F. J. McMorran appointed a committee, each member of which was selected to represent a branch of the industry. The original committee consisted of Paul Sodemann, *Chairman,* C. M. Baumgardner, John Falvey, John W. Cooper, C. R. Davis, and E. A. White, of St. Louis, who met with Mr. Turner and other officials of the school and decided upon the following points:

1. A definite need existed in St. Louis for an evening course in heating and ventilation.

2. The type of students to appeal to were the junior engineers and draftsmen, steamfitters, sheet metal workers, maintenance men and operators, and others similarly engaged.

3. THE A. S. H. V. E. GUIDE should be used as the basic text book for the course.

4. The selection of Walter Klein as instructor.

5. The St. Louis Chapter would sponsor the course and appoint an Educational Committee each year to cooperate with the faculty of the school in the future conduct of the course.

This course is now in its fifth year and the accompanying tabulation indicates the occupation of the students who enrolled in this course.

*Occupation of Student**	1929	1930	1931	1932	1933	*Total*
Heating Engineer	7	1	1			9
Heating Estimator	3	1	3	1		8
Heating Salesman	8	1	4		1	14
Heating Foreman				2		2
Heating Steamfitter			1	2	2	5
Heating Helper	2				2	4
Heating Inspector			1		2	3
Sheetmetal Contractor				1	5	6
Stationary Engineer	1	1				2
Plumbing Estimator				1		1
Plumbing Apprentice	1		2	1	5	9
Student (not employed)		1	2	1	1	5
Subtotal of those connected with heating and ventilating industry	22	5	14	9	18	68
Clerk	6	4	6	3	2	21
Electrician		1	1	1		3
Purchasing Agent	1					1
Journalist	1					1
Truck Driver	1					1
Total Attending	31	10	21	13	20	95

*As will be noted there is a very large percentage of the students from the ranks of the industry and many have returned for the second year work. Those who enroll, although not necessarily engaged in this field at the time, are men who have a natural inclination toward this kind of work or feel that they would like to follow it.

Some of these men and boys are entirely disillusioned and others become more enthused as the work progresses and in both cases the course serves a very useful purpose. In the case of the former student, he does not have to give up his present job and take one in the industry only to find that he is not interested in the work. Here as in no other place he can determine in a short space of time what it is all about and decide whether he wants to make it his life's work. The student who enjoys the work and continues the course in all cases has felt that the time and effort spent has been profitable.

For the past two years, since the recent popularity of summer comfort cooling, there has been an ever-growing demand for a new course in air conditioning or revision of the present course in heating and ventilating to include this work. Again conferring with the Educational Committee of the St. Louis Chapter, the officials of the school decided that the time was not yet ripe for such an addition to the curriculum, but, to stimulate interest in air conditioning generally and as a preparation for a future course, an Open Forum on Air Conditioning was conducted under the second provision of the Larkin Foundation.

This forum was conducted as a series of eight meetings and the subjects, speakers and attendance were as follows:

1st Forum Meeting—January 15, 1934
Subject: What Is Air Conditioning?
Speaker: E. A. Freund, Industrial Development Engr. in charge of the air cond. dept. of the Union Electric Light & Power Co.
Attendance: 700.

2nd Forum Meeting—January 22, 1934
(A) Subject: Heating in Air Conditioning.
Speaker: L. W. Moon, pres., *St. Louis Assn. Heating, Piping and Air Conditioning Contractors,* Council Member, A. S. H. V. E.
(B) Subject: Humidification in Air Conditioning.
Speaker: E. P. Bradley, Pres., Hester-Bradley Co.
Attendance: 630.

3rd Forum Meeting—January 29, 1934
(A) Subject: Cooling and Dehumidification.
Speaker: G. B. Rodenheiser, Head, Htg. and Vtg. Dept. of the Ranken School.
(B) Subject: Physiological Reactions of the Human Body.
Speaker: Dr. Herman Meyer.
Attendance: 465.

4th Forum Meeting—February 5, 1934
Subject: Cooling and Dehumidification (Equipment).
Speaker: C. E. Parmelee, Air Cond. Engr., Sears & Piou.
Attendance: 450.

5th Forum Meeting—February 12, 1934
Subject: Air Cleansing and Washing as a Part of Air Conditioning.
Speakers: Air Filters by Dwight Moodie, American Air Filter Co.; Air Washers by J. W. Cooper, Buffalo Forge Co.
Attendance: 434.

6th Forum Meeting—February 19, 1934
Subject: Properties of Air and Air Movement.
Speaker: C. A. Pickett, Herman Nelson Corp.
Subject: Air Ducts and Air Distribution.
Speaker: J. W. Cooper, Buffalo Forge Co.
Attendance: 410.

7th Forum Meeting—February 26, 1934.
Subject: Control Equipment.
Speaker: C. A. Davis, Johnson Service Co.
Attendance: 160.

8th Forum Meeting—March 5, 1934
Subject: Engineering in Air Conditioning.
Speaker: Paul Sodemann, Air Cond. Engr., Sodemann Heat & Power Co.
Attendance: 310.

The total attendance for the eight meetings was 3,559 persons. Each person attending was asked to fill out an attendance card on which they indicated their name and address and present occupation, a total of 663 cards being collected. These names were classified and the tabulation shows the present occupation of those attending. Under the heading of sales engineers were included all jobbing house salesmen, manufacturers agents, heating and plumbing estimators, refrigeration salesmen, etc.

For several weeks before the first forum meeting a mailing list of approximately 1,700 names were circularized, the list having been taken from the rolls of the A. S. H. V. E., *A. I. A., A. S. P. R. E., H. P. & A. C. C. N. A.*, as well as all manufacturers' agents, etc., in the telephone directory. The local newspaper carried an announcement prior to each meeting of the subject and the name of the speaker and the public was invited to attend, but, it will be noted that most of the response came from those who were in some way allied with the industry.

The forum has received much favorable comment and all of those associated with it were deeply gratified with the response and the results obtained.

Occupational Classification of Those Attending One or More Lectures of the Air Conditioning Forum at the Ranken Trade School, St. Louis, Mo.

From the Trades		*Professional*	
Sheet Metal Workers	66	Architects	21
Steamfitters	40	Engineers:	
Maintenance & Service	55	Mechanical	17
Plumbers	17	Electrical	13
Electricians	16	Heating & Ventilating	5
Machinists	12	Refrigeration	16
Operating Engineers	16	Chemical	6
Carpenter	1	Draftsmen	19
Painter	1	Teachers	3
Pattern Maker	1		100
	225	*Business Men in Trade*	
From Allied Lines		General Contractors	11
Oil Burners	6	Heating Contractors	41
Weatherstrip & Insulation	9	Sales Engineers	165
Ice Companies	9		217
Utilities	48	*The Public*	
Air Filters	2	Managers & Supts	8
Truck Driver	1	Shoe Workers	4
	75	Butchers	2
		Restauranteurs	2
		Grocers	4
		Unclassified	26
			46
Total	663		

Calvin Rice, Secretary of A.S.M.E., Dies

Engineering suffered an irreparable loss in the untimely death of Calvin W. Rice, secretary of the *American Society of Mechanical Engineers* for the last 28 years. Mr. Rice, who was 65 years old, died of a cerebral hemorrhage at the Murray Hill Sanatorium on October 2, 1934 and is survived by his wife, Mrs. Ellen M. Weibezahn Rice; a son, Edward Winslow Rice; and a daughter, Marjorie C. Rice.

Mr. Rice was born in Winchester, Mass., and received his early education in the public schools of Boston, New Haven, and Winchester. After graduation from Massachusetts Institute of Technology in 1890 with the degree of B. S. in electrical engineering, he entered the employ of the Thomson-Houston Electrical Co. at Lynn, Mass., as an assistant engineer. When this company was absorbed by the General Electric Co., Mr. Rice became an engineer at the Schenectady, N. Y., office, continuing in the power and mining department. In 1895 he was sent to Cincinnati as district engineer for the General Electric Co. and remained there only a short time before going to Colorado as electric superintendent for the Silver Lake Mines. After a year he became a consultant for the Anaconda Copper Mining Co. in Montana and later he returned to New York where he held various engineering positions with public utilities. Since 1903 he had been a vice-president and sales manager of the Nernst Lamp Co. and a consulting engineer for the General Electric Co.

Calvin Rice

After 15 years of varied experience in electrical, steam and hydraulic engineering, Mr. Rice became permanent secretary of the *A. S. M. E.* in 1906.

In 1926 Mr. Rice received an honorary degree of doctor of engineering from the Technische Hochschule in Darmstadt, Germany. He became an honorary member of the *A. S. M. E.* in 1932, which is a special distinction among engineers and scientists since there are only 17 honorary members of the organization throughout the world.

Mr. Rice held membership in many scientific organizations and was a member of the Corporation of Massachusetts Institute of Technology. He served as secretary and member of the board of trustees of the New York Museum of Science and Industry and was a member of the American Committee of the World Power Conference, a fellow of the *American Association for the Advancement of Science,* and a fellow and past vice-president of the *American Institute of Electrical Engineers.* He belonged to the Koninklijk Institute van Ingenieurs, Holland; the Masaryk Academy, Prague, Czechoslovakia; the Deutsches Museum, Munich, and many other organizations in Europe and South America.

In 1931 Mr. Rice received a medal of honor from the Verein Deutscher Ingenieure at its 50th anniversary meeting in Cologne, "in appreciation of services to technical-scientific achievement, particularly in promoting mutual international interests of engineers." He also received the title of knight in the Order of the White Lion from Czechoslovakia.

NOMINATIONS FOR 1935

The Nominating Committee appointed to select candidates for Officers of the Society for the coming year, 1935, submits the following list of nominees:

For President:

JOHN HOWATT, Chicago, Ill.

For First Vice-President:

G. L. LARSON, Madison, Wis.

For Second Vice-President:

D. S. BOYDEN, Boston, Mass.

For Treasurer:

A. J. OFFNER, New York, N. Y.

For Members of the Council:

Three-Year Term

J. F. MCINTIRE, Detroit, Mich.
ALBERT BUENGER, St. Paul, Minn.
F. E. GIESECKE, College Station, Texas
W. E. STARK, Cleveland, Ohio

Respectfully submitted,

NOMINATING COMMITTEE,

W. R. EICHBERG, *Chairman;*
W. G. BOALES, *Acting Secretary.*

In accordance with the provisions of the Amended Constitution, as given, ballots containing the names of the above candidates will soon be sent to the membership for voting upon prior to the Annual Meeting in January.

Art. B-VIII—Section 10. The Nominating Committee shall consist of one (1) member eligible to vote designated by each Chapter, or his alternate also appointed by the Chapter. The Secretary of each Chapter shall certify to the Secretary of the Society on or before January first the names of the member and alternate selected.

The Committee shall meet at the Annual Meeting of the Society at the call of the Secretary of the Society and shall effect its own organization and elect its own Chairman. At the Semi-Annual Meeting of the Society, if possible, the Nominating Committee shall select the nominees for the ensuing year for the offices of President, First Vice-President, Second Vice-President, Treasurer, and four (4) members of the Council. In any event the names of the nominees shall be certified to the Secretary of the Society before September twentieth, with the written consent of each nominee to fill the office for which he has been selected and their names with the offices to which they have been nominated shall be published in the October issue of the JOURNAL.

Art. B-IX—Section 2. The Secretary shall prepare ballots with the names of all candidates and forward them to the members, eligible to vote, at least thirty (30) days before the date of the Annual Meeting.

Nominations for Members of Committee on Research

Although committees of the Society are usually appointed, in view of the great importance of the Committee on Research and the financial responsibility it would be called upon to assume, it has been made more representative of the entire membership of the Society by a process of *election.* The election is governed by the By-Laws for the election of officers, with the single exception that Members of the Committee on Research are nominated by the Council instead of by a Nominating Committee.

In accordance with the Regulations for the Government of the Research Laboratory, adopted at the January, 1919, Meeting, and amended January, 1933, the Council announces the nomination of the following members of the Committee for election to succeed those members whose present terms expire January, 1935:

Three-Year Term

C. A. DUNHAM, Chicago, Ill.
W. L. FLEISHER, New York, N. Y.
ELLIOTT HARRINGTON, Schenectady, N. Y.
A. P. KRATZ, Urbana, Ill.
H. C. MURPHY, Louisville, Ky.

The regulations governing the nomination and election of members of the Committee on Research are as follows:

ARTICLE II—ORGANIZATION

Section 1. *Committee on Research*—There shall be a standing committee known as the Committee on Research, consisting of fifteen (15) members each serving for three (3) years and five (5) retiring each year. The outgoing Chairman if serving in that capacity during the last year of his three (3) year term on the Committee shall without election become an additional member of the Committee on Research for one (1) year.

(a) The Council shall nominate previous to July first of each year five (5) members to fill the vacancies of those retiring at the next Annual Meeting.

(*b*) The nominations made by the Council shall be published in the October issue of the Society's Journal.

(*c*) Any ten (10) members of the Society eligible to vote may present to the Secretary over their signatures, the name of one (1) or more additional nominees for the Committee on Research, provided such name or names are presented at least sixty (60) days prior to the next Annual Meeting, and such additional nominations shall be placed on the ballot opposite the nominations made by the Council.

(*d*) The election shall otherwise conform to the regulations provided for the election of officers of the Society in the Constitution, By-Laws and Rules.

(*e*) Vacancies may be filled by the Council, such persons chosen by the Council to serve until a successor is elected at the next Annual Meeting.

Albright Art Gallery

Going to Buffalo?

JANUARY 28-30, 1935, will provide busy and pleasant days for A.S.H.V.E. members and guests who attend the 41st Annual Meeting of the Society at the Hotel Statler, Buffalo, N. Y. On this occasion the Western New York Chapter will play the part of host and plans are actively under way by the following Committee on Arrangements, who are in charge: M. C. Beman, *Chairman;* Roswell Farnham, *Vice-Chairman;* L. A. Harding, *Reception;* J. J. Landers, *Registration;* Walter Voisinet, *Banquet;* C. W. Farrar, *Publicity;* Mr. and Mrs. Park Hedley, *Ladies;* D. J. Mahoney, *Entertainment;* C. A. Evans, *Transportation;* and B. C. Candee, *Finance.*

Buffalo is a city of beauty and historic interest situated on Lake Erie within a few miles of Niagara Falls and Lake Ontario. It is often called the Gate-Way of the West and its numerous transportation facilities make it easily accessible from all sections of the United States and Canada. Reduced Fare Identification Certificates being sent to members make possible an economical trip. Hotel rates are low and the room accommodations and good food insure the guests comfort and happiness.

An interesting program has been prepared and registration of members will begin at 8:30 a. m. on Monday, January 28, and the first session will open at 9:30 a. m. A paper by Prof. T. G. Estep, Carnegie Institute of Technology, on Some Recent Studies on the Ashes in Coal, will be presented. The reports of four Council committees will be given and the tellers of election will report results of the election of new officers. Ballots are being sent to members December 15 and the polls close January 10. An important committee report will be that suggesting changes in the Constitution, By-Laws, and Rules, which have been under careful study.

At 2:30 p. m. the second session will begin and the first item scheduled is the Report of the Committee on Research. A paper on Study of the Room Cooling Load in an Office Building, by F. C. Houghten and Carl Gutberlet, will be a presentation of the Research Laboratory. Results of cooperative research will be reported in a paper, Study of Summer Cooling in the Research Residence for the Summer of 1934, by A. P. Kratz, S. Konzo, M. K. Fahnestock, and E. L. Broderick, of the University of Illinois.

This year the Past Presidents will meet for dinner at 7:00 p. m. on Monday and will be saddened by the loss of Dean F. Paul Anderson, a former member of this group, who added much to the enjoyment of this annual occasion. W. T. Jones will attend his first dinner as a past president and receive initiation.

The third session will open at 9:30 a. m., January 29, with a report of the Guide Publication Committee. Two technical papers will be given, one of which will be The Nature of Ions in Air and Their Possible Physiological Effects, by Prof. L. B. Loeb of the University of California.

At 2:00 p. m. the Ventilation Standards Committee will report during the fourth session. Prof. C.-E. A. Winslow and Dr. Leonard Greenburg, of the John B. Pierce Laboratory of Hygiene, have prepared a paper on The Thermo-Integrator—A New Instrument for the Observation of Thermal Interchanges. Cooperative research studies on minimum air quantities will be discussed in a Preliminary Report of Minimum Ventilation Requirements by C. P. Yaglou of Harvard School of Public Health.

The annual banquet and dance will be a festive occasion on Tuesday evening at 7:00 p. m. and Walter Voisinet is in charge of arrangements. A good time is anticipated with the elimination of speeches and plenty of entertainment and dancing.

A paper resulting from cooperation with the Technical Advisory Committee on Heat Requirements of Buildings will discuss this subject and be presented at the fifth session at 9:30 a. m., January 30. The authors are J. H. Walker and G. H. Tuttle, of the Detroit Edison Co. A paper by G. L. Larson, D. W. Nelson, and John James, of the University of Wisconsin, will give cooperative research results on Tests of Three Heating Systems in an Industrial Type of Building.

The final session will open at 2:00 p. m. with the installation of new officers. A paper of timely interest on the program is the Study of Unit Room Coolers in the Research Residence, by A. P. Kratz, M. K. Fahnestock, and S. Konzo, a cooperative research paper. A second presentation from the Research Laboratory by F. C. Houghten will give an Analysis of Studies on Heating an Office Building. Following discussion of the technical papers, new business will be in order, and the meeting officially will be brought to a close after the presentation of appropriate resolutions.

Plans for the entertainment of ladies are progressing and several lively parties are in prospect.

The Western New York Chapter extends a hearty invitation to all A.S.H.V.E. members and guests to come to the 41st Annual Meeting and hopes that a great many will be in Buffalo to enjoy their hospitality during January 28-30, 1935.

RAILROAD RATES TO BUFFALO

From	*One Way*	Round Trip *Convention Fare*	Pullman *Lower Berth*
New York	$ 15.72	$ 21.00	$ 3.75
Philadelphia	14.98	20.00	3.75
Baltimore (via Harrisburg)	14.27	19.05	4.50
Washington	15.71	20.95	4.50
Cincinnati	15.79	21.10	4.50
Pittsburgh	9.20	12.30	3.75
Cleveland	6.64	8.90	3.75
Detroit	9.00	12.00	3.00
Grand Rapids	13.91	18.55	4.50
Chicago	18.81	25.10	5.63
Milwaukee	21.36	28.50	5.63
Minneapolis	31.02	41.40	8.13
Indianapolis	16.87	22.50	5.63
St. Louis	25.74	34.35	7.50
Kansas City	32.59	43.50	8.63
Atlanta	30.21	40.28	7.75
New Orleans	39.19	52.26	10.50
Jacksonville	39.39	52.52	10.25
Denver	49.87	66.50	12.88
Seattle	81.65	108.87	19.50
Portland	81.65	108.87	19.50
San Francisco	83.84	111.79	21.38
Los Angeles	83.84	111.79	21.38

PROGRAM
41st ANNUAL MEETING
AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS
Hotel Statler Jan. 28-30, 1935 Buffalo, N. Y.

January 27 (Sunday)

2:30 p. m. Meeting of Council.

January 28 (Monday)

8:30 a. m. Registration.

9:30 a. m. First Session—
- Greeting.
- Response by C. V. Haynes, President.
- Reports of Officers.
- Technical paper:
  - Some Recent Studies on the Ashes in Coal, Prof. T. G. Estep.
- Reports of Council Committees.
- Report of Committee on Revision of Constitution, By-Laws, and Rules.
- Report of Tellers of Election.

2:30 p. m. Second Session—
- Report of Committee on Research.
- Technical papers:
  - Cooling Requirements of Rooms in an Unconditioned Office Building, F. C. Houghten and Carl Gutberlet.
  - Study of Summer Cooling in the Research Residence for the Summer of 1934, A. P. Kratz, S. Konzo, M. K. Fahnestock, and E. L. Broderick.

7:00 p. m. Past Presidents Dinner.

January 29 (Tuesday)

9:30 a. m. Third Session—
- Report of Guide Publication Committee.
- Technical paper:
  - The Nature of Ions in Air and Their Possible Physiological Effects, Prof. L. B. Loeb.

2:00 p. m. Fourth Session—
- Technical papers:
  - The Thermo-Integrator—A New Instrument for the Observation of Thermal Interchanges, C.-E. A. Winslow and Leonard Greenburg.
  - Preliminary Report of Minimum Ventilation Requirements, C. P. Yaglou.
- Report of Ventilation Standards Committee.

7:00 p. m. Banquet and Dance.

January 30 (Wednesday)

9:30 a. m. Fifth Session—
- Technical papers:
  - The Heat Requirements of Buildings, J. H. Walker and G. H. Tuttle.
  - Tests of Three Heating Systems in an Industrial Type of Building, G. L. Larson, D. W. Nelson, and John James.

2:00 p. m. Sixth Session—
- Installation of Officers.
- Technical papers:
  - Study of Unit Room Coolers in the Research Residence, A. P. Kratz, M. K. Fahnestock, and S. Konzo.
  - Analysis of Studies on Heating an Office Building, F. C. Houghten.
- New Business.
- Resolutions.

4:30 p. m. Council Meeting.

REDUCED RAIL FARES FOR ANNUAL MEETING

(1) The rate of one and one-third fares for the round trip is guaranteed to all Society members under the Identification Certificate Plan.

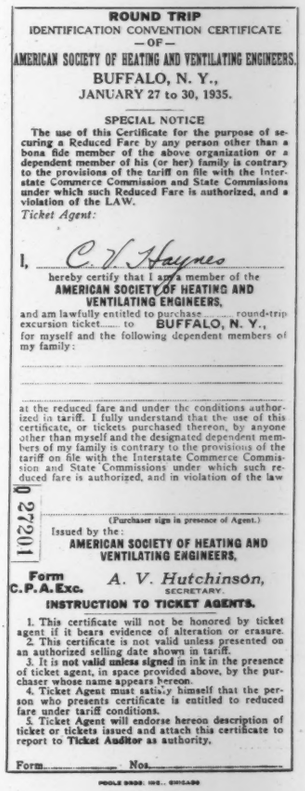
(2) On January 2nd certificates will be mailed to all members in the United States and Canada.

(3) The identification certificate must be presented to the local ticket agent at the time of buying round-trip ticket to Buffalo.

(4) One identification certificate may be used by a Society member and his family.

(5) Reduced fare round-trip tickets bought on the Identification Certificate Plan are good for 30 days and may be used on one route going and an alternate route returning if this is specified at the time of purchasing a ticket.

(6) At Buffalo before making the return trip the member must have his ticket stamped at the ticket window in the station, otherwise the return portion of the ticket will not be honored for passage.



ROUND TRIP
IDENTIFICATION CONVENTION CERTIFICATE
— OF —
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
BUFFALO, N. Y.,
JANUARY 27 to 30, 1935.

SPECIAL NOTICE
The use of this Certificate for the purpose of securing a Reduced Fare by any person other than a bona fide member of the above organization or a dependent member of his (or her) family is contrary to the provisions of the tariff on file with the Interstate Commerce Commission and State Commissions under which such Reduced Fare is authorized, and a violation of the LAW.

Ticket Agent:

I, C. V. Haynes
hereby certify that I am a member of the
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS,
and am lawfully entitled to purchase ____ round-trip excursion ticket..... to BUFFALO, N. Y., for myself and the following dependent members of my family:

.....

.....

at the reduced fare and under the conditions authorized in tariff. I fully understand that the use of this certificate, or tickets purchased thereon, by anyone other than myself and the designated dependent members of my family is contrary to the provisions of the tariff on file with the Interstate Commerce Commission and State Commissions under which such reduced fare is authorized, and in violation of the law

10220

(Purchaser sign in presence of Agent.)

Issued by the:
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS,

Form C.P.A. Exc. A. V. Hutchinson, SECRETARY.

INSTRUCTION TO TICKET AGENTS.

1. This certificate will not be honored by ticket agent if it bears evidence of alteration or erasure.
2. This certificate is not valid unless presented on an authorized selling date shown in tariff.
3. It is **not valid unless signed** in ink in the presence of ticket agent, in space provided above, by the purchaser whose name appears hereon.
4. Ticket Agent must satisfy himself that the person who presents certificate is entitled to reduced fare under tariff conditions.
5. Ticket Agent will endorse hereon description of ticket or tickets issued and attach this certificate to report to **Ticket Auditor** as authority.

Form..... Nos.....

A. S. H. V. E. Booth at Power Show

At the 11th National Exposition of Power and Mechanical Engineering being held at Grand Central Palace, New York, N. Y., December 3-8, the Society is represented by a booth displaying photographs and data obtained from its work at the A. S. H. V. E. Research Laboratory and cooperating institutions.

A. S. M. E. Domestic Heating Session

During the Annual Meeting of the *A. S. M. E.* a session on Domestic Heating was held on Tuesday afternoon, December 4, at 2:00 p. m., in the Engineering Societies Auditorium, New York City. The presiding officer was R. A. Sherman and M. D. Engle served as recorder.

The following papers were scheduled for presentation: Experience with Application of Central Station Practice to Domestic Heating, by M. K. Drewry, Milwaukee, Wis.; The Use of Oil in Domestic Heating, by Prof. L. E. Seeley, New Haven, Conn.; and The Use of Gas in Domestic Heating, by Prof. R. B. Leckie, Lafayette, Ind.

American Engineering Council Meeting Dates

On January 10, 11, and 12, 1935, the *American Engineering Council* will hold its annual meeting in Washington, D. C., when it is planned to spend two days in a meeting of the assembly and one day in committee discussions.

S. P. E. E. Committee on Engineering Research

The *Society for the Promotion of Engineering Education* anticipates expansion in its interest and activity in engineering research and has recently appointed a Committee on Engineering Research, on which the following will serve during 1934-35: C. F. Harding, *chairman*, H. C. Berry, C. H. Berry, O. G. C. Dahl, F. E. Giesecke, W. B. Gregory, F. B. Jewett, G. L. Larson, F. T. Mavis, H. F. Moore, C. T. Morris, S. Timoshenko, B. R. Van Leer, and C. B. Veal.

Direct s Sales of Air Conditioning Equipment

Elliott Harrington, engineer in charge of the commercial engineering division of the air conditioning department of General Electric Co., has been closely associated with the growth of the department since its formation. He was recently appointed by J. J. Donovan, manager of the department, to take charge of the sale of unified air conditioning systems, in addition to his other engineering duties.

H. F. Tapp Assumes New Duties

On November 15 Harry F. Tapp entered his new duties as assistant to the President of Gilbert and Barker Manufacturing Co., R. C. A. Bldg., Rockefeller Center, New York. For a number of years Mr. Tapp was Secretary of the American Oil Burner Association.

W. R. Eichberg Returns to Office

W. Roy Eichberg, secretary of the Philadelphia Chapter, has returned to his desk fully recovered from an emergency operation performed early in October.

Smoke Abatement Exhibit to Be Continued

The smoke abatement exhibit at the 1934 Century of Progress exposition in Chicago has attracted so much attention that it will be installed temporarily and perhaps permanently at the Rosenwald Museum of Science and Industry. This exhibit, sponsored by railroads, coal operators, coal merchants and equipment manufacturers, has been one of the most interesting scientific and educational displays at the exposition.

Civic leaders and others interested in fuel utilization contemplate the organization of an institute for the purpose of carrying on a campaign of education, conducting research work, and maintaining working exhibits of equipment used to eradicate the smoke nuisance.

A. S. M. E. Medal Awarded to W. H. Carrier

The Board of Award of the A. S. M. E. announced that the A. S. M. E. Medal for 1934 had been awarded to W. H. Carrier, Newark, N. J., the presentation being made at the dinner to new members on the evening of December 5, during the annual meeting of the *American Society of Mechanical Engineers* in New York City.

The medal, which was established in 1920 for distinguished service in engineering or science, was awarded to Mr. Carrier

in recognition of his research and development work in air conditioning.

Mr. Carrier was president of the A. S. H. V. E. in 1931 and is a member of the Advisory Council of the Society. He is also a past president of the *A. S. R. E.* and is chairman of the board of Carrier Corp.

In addition to the A. S. M. E. Medal, Mr. Carrier has been the recipient of the F. Paul Anderson Medal of the A. S. H. V. E. and the John Scott Medal of the City of Philadelphia, both of which were presented to him in 1932.

Survey of Engineering Profession Announced

The Bureau of Labor Statistics of the U. S. Department of Labor will make a survey of the engineering profession in cooperation with *American Engineering Council* and other engineering societies, to determine a workable plan for improving the status of engineers. The survey will be conducted under the guidance of American Engineering Council's Committee on Engineering and Allied Technical Professions, of which G. T. Seabury is chairman.

Of major interest will be the attention given to engineering employment, the professional status of engineers and how to forward it, the public works program, Federal housing, surveying and mapping, competition of government with private engineers, the best type of publicity to advance professional interests, and many other matters of vital concern to engineers in all parts of the country.

A profession-wide survey to show how engineers have fared through the hard times is being made and unsigned confidential questionnaire returns from 100,000 individuals will give salary trends, types of employers and duties over the past several years, in addition to educational background and other facts designed to give a true picture of the engineers' status.

Furnace Manufacturers Visit Laboratory

The *National Warm Air Heating and Air Conditioning Association* holding its annual convention at the Hotel William Penn, Pittsburgh, Pa., December 4, 5, 6, had a fine program opening on Wednesday morning, with a talk on the Federal Housing Program by A. O. Eberhart, Washington, D. C., followed by presentations entitled: Layouts for Air Conditioning Including Mechanical Heating, J. E. Maynard; Our Technical Educational Committee, J. H. Van Alsburg; and The Industry's Installation Codes, Prof. J. D. Hoffman. Pres. H. T. Richardson was chairman of the first session.

The afternoon session was presided over by Vice-Pres. W. L. Rybolt and the NRA Codes affecting the roofing and sheet metal contracting, the furnace manufacturing, the register manufacturing, and the furnace pipe and fittings industries were discussed. Members were privileged to hear an address by C. F. Kettering, Detroit, Mich., and a paper on The Comfort Chart and Cold Wall Effect was presented by F. C. Houghten, director of the A. S. H. V. E. Research Laboratory. Reports from committee chairmen and the election of officers followed.

A research session on Thursday morning opened with Vice-Pres. L. R. Taylor presiding. A report from the Research Advisory Committee was received and The New Research Reference Volume was described by Prof. J. D. Hoffman. Two technical papers of interest were Design and Performance Problems in Forced Air Heating and Air Conditioning, by Prof. A. P. Kratz, and Studies in Summer Cooling in the Research Residence During the Summer of 1934, by S. Konzo.

Pres. H. T. Richardson served as chairman of the afternoon session held in the U. S. Bureau of Mines. A paper on Combustion and Fuels was presented and an inspection trip of the A. S. H. V. E. Research Laboratory was made.

A. S. R. E. 30th Annual Meeting

The 30th Annual Meeting of the *American Society of Refrigerating Engineers* took place December 5, 6, 7, at the Hotel New Yorker, New York City. At this time tribute was paid to 19 charter members who are on the roster and who were present as guests of honor.

The meeting opened at 10:00 a. m., December 5, when Pres. A. R. Stevenson, Jr. served as chairman. Three technical papers were presented as follows: Air as a Refrigerant by R. U. Berry; Air Conditioning and Odor Control, Philip Drinker and W. M. Pierce; and Visual Heat Transfer Measurement, by A. D. Moore.

A welcome luncheon was enjoyed at 12:30 p. m., when D. C. Coyle, member of the NRA Review Board, engineer and author, addressed those present.

The second session was devoted to a discussion of refrigeration of foods with A. H. Baer serving as chairman. Storage of Meat—A Review of Investigations was presented by A. W. Ewell and the Advancement and Achievements of Quick Freezing was discussed by Gardner Poole. A. R. Stevenson, Jr., showed a slide film on Refrigeration and Its Place in the Engineering World.

A session on Thursday morning was presided over by H. Harrison, Vice-President of the *A.S.R.E.* The topic, refrigerating equipment, was introduced and L. H. Philipp presented a paper on The Thermo-Physics of Liquid Refrigerant Controls. Progress in Refrigerator Car Practice was discussed by W. V. Hukill and E. E. Ashley described a Department Store Conditioning System. The annual dinner dance took place at 7:30 p. m.

The final session opened on the morning of December 7 with Glenn Muffly serving as chairman. The commercial domestic field was the topic under discussion. W. R. Woolrich described Refrigeration in the T.V.A. Standards and Codes for Small Refrigerating Machines were discussed in a paper by W. M. Timmerman and Siegfried Ruppricht presented Beer Dispensing.

Code Authority Memberships Recognized

In a recent announcement from the National Recovery Administration, recognition of the following Code Authority memberships is given: *Boiler Manufacturing Industry*—S. H. Barnum, The Bigelow Co., New Haven, Conn.; Owsley Brown, Springfield Boiler Co., Springfield, Ill.; M. E. Finek, Murray Iron Works, Burlington, Iowa; E. C. Hutchinson, Edge Moor Iron Co., Edge Moor, Del.; W. F. Keenan, Jr., Foster Wheeler Corp., New York, N. Y.; H. B. Kendall, M. W. Kellogg Co., New York, N. Y.; R. B. Mildon, Westinghouse Electric & Mfg. Co., Philadelphia, Pa.; A. G. Pratt, The Babcock & Wilcox Co., New York, N. Y.; A. W. Strong, Strong-Scott Mfg. Co., Minneapolis, Minn.; and A. C. Weigel, Combustion Engrg. Co., New York, N. Y.

Oil Burner Industry: Area I, R. G. Whipple, Harvey Whipple, Inc., Springfield, Mass., manufacturer representative, and Alfred Buckley, Buckley & Scott, Inc., Providence, R. I., dealer representative; Area II, J. A. Lattner, Century Engrg. Corp., Cedar Rapids, Iowa, manufacturer representative, and R. S. Porter, Belden-Porter Co., Minneapolis, Minn., dealer representative; Area III, A. J. Fleischmann, May Oil Burner Corp., Baltimore, Md., manufacturer representative, and M. M. Oppenheimer, Oil Heat, Inc., Baltimore, Md., dealer representative; Area IV, N. S. Hayward, Ray Burner Co., San Francisco, Calif., manufacturer representative, and A. Michael, Pacific Century Co., Portland, Ore., dealer representative; J. J. Donovan, General Electric Co., New York, N. Y., manufacturer representative at large.

Illinois

October 8, 1934. The annual meeting and dinner of the Illinois Chapter with an attendance of 54 was held at the Hotel Sherman with Pres. C. W. DeLand presiding.

C. M. Baumgardner, C. F. Hayden and G. G. Turner were selected as tellers to count the ballots for Chapter officers and Board of Governors for the year 1934-35.

The following four new members were welcomed to Chapter membership: J. R. Borling, L. Peller, J. F. Tobin, and F. C. Warren.

The secretary, J. J. Hayes, read the Board of Governors' annual report to the chapter. Past President E. P. Heckel congratulated the Board of Governors upon the completeness and excellence of the report and moved that a copy be prepared and mailed to each member.

J. H. Milliken presented the treasurer's report, which was favorably commented upon by President DeLand.

E. N. McDonnell, chairman of the Auditors Committee, reported that his committee had audited the books of the treasurer and approved of the report as submitted.

Committee activities were outlined by S. I. Rottmayer, chairman of the Meetings Committee, and the excellent programs during the last year testify to the splendid work which was done. Mr. Rottmayer's suggestions to the incoming Meetings Committee will be of great aid and assistance in planning the meetings of the coming year.

R. E. Hattis, chairman of the Membership Committee, reported that 11 new members were added during the year.

The Illinois Chapter welcomed to their meeting Nikolai Alfsen, A.S.H.V.E. member from Oslo, Norway, and Axel Rosell, Stockholm, Sweden, who made an extensive tour of the United States.

P. G. Drautzburg, Secret Service Division, U. S. Treasury Department, spoke on Counterfeiting. He had no difficulty in holding the attention of every one present for over an hour. Mr. Drautzburg described counterfeit currency, the method usually used to print it, the means employed to recognize it, and finally the patience and care required of the department members in capturing and convicting the counterfeiter. Many examples of counterfeiter's art were shown.

The interest of all the members proved to the committee the value of occasional non-technical talks during the year.

The tellers then reported the following results of the election:

President—R. E. Hattis

Vice-President—J. H. Milliken

Secretary—L. S. Ries

Treasurer—J. J. Hayes

Board of Governors—G. H. Blanding, J. J. Haines, S. I. Rottmayer.

Retiring President DeLand then introduced the new officers and ended his most successful year with a very gracious speech.

President Hattis made some pertinent remarks, predicting a bright future for Illinois Chapter.

The new secretary, L. S. Ries, was unable to be present, being confined in a hospital with a serious illness. Mr. Hayes will carry on as Acting Secretary until Mr. Ries can assume the duties.

Under the subject of new business, E. P. Heckel suggested that the Board of Governors consider giving nominal compensation to the Chapter secretary, rather than providing for attendance at the Annual and Semi-Annual Meetings of the Society. J. J. Aeberly spoke on the care required in the selection of the Chapter's representative to the A.S.H.V.E. Nominating Committee, and its relationship to the secretary's attendance at meetings. The matter was referred to the Board of Governors for discussion.

Michigan

October 10, 1934. The first meeting of the 1934-35 season of the Michigan Chapter was enjoyed by 21 members and guests who played golf in the afternoon at the Detroit Golf Club and by 42 who were present at dinner. Roll call was taken and the minutes of the previous meeting were read and approved.

The treasurer reported a balance of $146.00 in the treasury with no outstanding bills. A request was made for prompt payment of dues for the current season amounting to $4.00.

The speaker of the evening was H. R. Smith, attorney for the *Michigan Bankers Association,* who explained the operation of the Better Housing Program under the National Housing Act. Following Mr. Smith's talk, the government visomatic talking picture was shown.

The meeting adjourned at 10:30 p. m., according to the report of the secretary, W. F. Arnoldy.

Western Michigan

October 8, 1934—Eleven members and 24 guests were present at the first meeting of the Western Michigan Chapter, held at the Rowe Hotel in Grand Rapids.

Miss Frances Florer, attorney of the Detroit office of the Better Housing Division of the Federal Housing Administration, gave a very interesting talk on the Better Housing Program and its reception by home owners, manufacturers, engineers, bankers and contractors, in various Michigan communities. A three-reel visomatic sound film of special interest to the large number of contractors who were guests was also presented.

F. E. Ederle, of the Builders and Traders Exchange, discussed the construction industry campaign which is underway in Grand Rapids.

The following committees were appointed for the season:

Speakers and Educational—C. R. McConner, *Chairman,* O. D. Marshall, L. G. Miller.

Entertainment and Program—K. L. Ziesse, *Chairman,* J. F. Johnston, Jr., J. J. Troske.

Reception—W. W. Bradfield, P. O. Wierenga, H. J. Young, J. Skillman.

Membership—J. H. Van Alsburg, *Chairman,* R. W. Wilson, Harry Christenson, J. J. Troske, H. F. Reid, L. G. Miller.

Employment Representative—Cornelius Lammers.

Publicity—Harry Christenson, *Chairman,* H. A. Brinker, O. D. Marshall, E. J. Adams.

Nominating Representative—K. L. Ziesse; *Alternate*—J. H. Van Alsburg.

The applications of three new members were received and approved for membership in a Board of Governors meeting, which followed.

Minnesota

October 8, 1934. One hundred and one members and guests of the Minnesota Chapter were on hand to welcome First Vice-President John Howatt, Chicago, Ill., and E. V. Hill, a past president of the Society, at the regular monthly meeting held at the Minnesota Union. Pres. C. E. Lewis called the meeting to order and turned over the gavel to F. B. Rowley, a past president of the A. S. H. V. E., who acted as chairman.

Mr. Howatt, Chairman of the Committee on Research, was presented and outlined the research activities of the Society. He discussed in greater detail several projects being conducted at the Research Laboratory in Pittsburgh and at universities with which the Society has cooperative agreements. Mr. Howatt called attention to the fact that more than half a million dollars has been spent in research by the Society and cooperating universities and he stated that at present 15 projects are in progress, on which 103 men are actively engaged.

Dr. E. Vernon Hill, the second guest speaker of the evening, gave a very interesting illustrated talk on the subject of The People Versus Bad Air. The fundamentals of air conditioning and the effects of unconditioned air on health were forcefully brought to the attention of the members by Dr. Hill.

Both talks inspired a lively technical discussion, which was led by Professor Rowley. The speakers were tendered a rising vote of thanks by the audience which outnumbered the total membership of the Chapter by 25.

September 17, 1934. The Minnesota Chapter began its 1934-35 activities with an inspection tour of Hamm's Brewery. Following a supper served in the Dutch Room, the meeting was called to order by Pres. C. E. Lewis.

Albert Buenger introduced W. A. Lange, mechanical superintendent, who explained the brewing process and discussed the relation of a new power plant to the brewery's requirements. Mr. Buenger described the power plant, after which the members were conducted on a tour of inspection.

So interesting was the meeting that none of the 65 members and guests present thought to suggest adjournment until 10:00 p. m.

New York

November 19, 1934. When Pres. H. W. Fiedler called the meeting to order, 91 members and guests were present to hear the talk of A. Warren Canney, air conditioning engineer on the staff of Clyde R. Place, consulting engineers, speak on air conditioning.

Mr. Canney's talk was in three parts. The first, devoted to the background and advantages of air conditioning, gave his audience an opportunity to appreciate the outlook the designers of the Rockefeller Center air-conditioning systems have on the subject. Mr. Canney said that, in his opinion, shelter should not be looked on as the principal objective of a building, but that that particular requirement should be taken for granted, and that healthful, comfortable indoor conditions were really the principal objectives.

In pointing out the reasons for using air conditioning, Mr. Canney said that many building owners lost sight of the detailed and not so highly publicized advantages, 22 of which he detailed.

In the second part of his talk some of the air conditioning installations of Rockefeller Center were discussed, with particular stress on the conditioning of the Music Hall.

Mr. Canney mentioned that the design of an air conditioning system for a commercial building differed from that of an industrial plant or a theater in that the system had to be flexible enough so that a given space could be properly conditioned regardless of the type of tenant. One tenant using a certain space might require as much as 20 times the air conditioning load of another tenant in the same space a year later.

A psychrometric chart which the author developed was explained in the third part of his talk. The purpose of this chart

was to make possible the graphic solution of air conditioning problems.

The speaker of the evening was introduced by J. R. Hertzler, Jr.

During the progress of the dinner a few business details were introduced by President Fiedler. Sec. T. W. Reynolds read the names of 26 new Chapter members and the various Committee Chairmen, Messrs. H. B. Eells, *Attendance,* Louis Hament, *Reception,* Clifford Strock, *Publicity,* and H. G. Meinke, *Membership,* were introduced and complimented for their efforts.

A. V. Hutchinson, Secretary of the Society, gave a brief explanation of the Council's recent action on the deferred payment plan for dues in arrears.

Announcement was made that the December meeting of the Chapter would be in the form of a dinner and bridge for members and their wives and guests.

October 15, 1934. Addresses on the Federal Housing Administration, English Practice in Heating and Ventilating, and A.S.H.V.E. Activities were the three features of the first meeting of the 1934-35 season of the New York Chapter, held at the Building Trades Employers Club. Ninety members attended, 54 of whom were present at the dinner which preceded the meeting. J. M. Gerard, regional director for the State of New York of the Better Housing Division, Federal Housing Administration, was the speaker who discussed the government's modernizing program, while C. V. Haynes, president of the A.S.H.V.E., told the members of their Society's activities.

J. N. Russell, London, England, who had been touring the United States studying American heating, ventilating and air conditioning practice, briefly reviewed some of the outstanding differences between engineering in England and the United States. Mr. Russell's firm, which has been in business for 125 years, is engaged in both engineering and contracting and recently completed the heating and ventilating installation in the Bank of England. Mr. Russell pointed out that whereas in this country designs are made for temperature differences of 70 deg, in England the maximum temperature difference is 35 deg. The smaller maximum load permits the use of 2 and 3 column radiators, as compared with the 5 and 6 column commonly used here. Furthermore, due to the large number of open fires burning soft coal, the soot content of the air is extremely high and this, coupled with the high humidity, blackens the walls near the radiators and grilles so that they require frequent cleaning.

Engineers in England have one severe obstacle, resulting from a building act passed many years ago, which requires that hot water pipes must be 3 in. or more from wood surfaces, steam pipes 6 in. or more, and warm air pipes 9 in. or more, regardless of the amount of insulation on the pipes.

Mr. Russell is a past president of the *Institution of Heating and Ventilating Engineers* of Great Britain and the oldest British member of the A.S.H.V.E.

According to Mr. Gerard, in his talk on the Federal Housing Administration, one manufacturer of heating equipment received 2,749 applications for loans on FHA provisions in 30 days which gave some indication of the interest in this campaign. The same manufacturer, Mr. Gerard said, reports a 50 per cent gain in the number of loans each week as compared with the previous week. The Federal Housing Administration is sending out 30,000 booklets per day, explaining the features of the Act to building owners, contractors and others. The average of loans made so far has been $443 to home owners with an average income of $2,711 to extend over a period averaging 26 months.

The speaker reminded his audience that of those on the relief rolls in New York, one out of every four is out of work due to the lack of activity in the construction industry, and urged the necessity of support of the government's program in order that this important industry be revived. He stressed the fact that modernization is only part of the administration's program and that it was anticipated that Title II of the Act, which would make available mortgage money for new homes would soon go into effect. This is expected to start activity in building, necessary since it is now estimated that there is a shortage of approximately one and one-half million homes.

Pres. C. V. Haynes reviewed the history of the New York Chapter and mentioned that the Chapter should be proud of its honor roll of past presidents of the Society, who were members of the local Chapter. Mr. Haynes also spoke of the activities and status of the A.S.H.V.E. during the past year, including the Research Program and the work of the Guide Publication Committee.

Western New York

October 8, 1934. The first fall meeting of the Western New York Chapter was held at the Touraine Hotel with 20 members and guests present at dinner and 25 at the business session.

M. C. Beman, general chairman of the Committee on Arrangements for the Society's Annual Meeting, briefly outlined the activities to date and requested the assistance of all members.

The speaker of the evening was E. G. Speyer, consulting engineer for Buffalo Planning Board, who gave a very interesting discourse entitled, Water Front Development and Major Street Plans. Considerable discussion followed and Mr. Speyer replied to many questions which were asked.

The members also enjoyed talks from Mr. Wilson of the Buffalo Chamber of Commerce and Mr. Gertis of the Federal Housing Administration.

Pacific Northwest

October 18, 1934. Pres. A. L. Pollard presided at the October meeting of the Pacific Northwest Chapter held at the Hungerford Hotel and welcomed 18 members and guests.

A dinner at 6:30 p. m. was followed by a visomatic film presented by the local office of the Federal Housing Administration. Slides, accompanied by a talk of particular interest to engineers, contractors, and dealers comprised a portion of the program.

The guest speaker of the evening was Prof. F. K. Kirsten, of the University of Washington, who with the aid of plans and diagrams described in detail an aviation wind tunnel which is to be built on the campus of the University of Washington. The test chamber of the tunnel is to be capable of testing model planes in air velocities up to 250 mph. Air will be moved by two propeller type fans driven by one shaft to which will be connected four 250 hp motors. This tunnel has been designed under Professor Kirsten's supervision on the campus of the university and will be one of the most modern and develop greater wind velocities than any now in use.

Points of interest to ventilating engineers in the matter of handling air were brought out, making the meeting in every way an instructive and enjoyable one, as reported by the secretary, S. D. Peterson.

Philadelphia

October 11, 1934. The regular meeting of the Philadelphia Chapter, held at the Engineers Club, was opened with Pres. W. P. Culbert in the chair. The minutes of the previous meeting were read and approved and the report of the treasurer, W. F. Smith, was submitted and ordered spread upon the records.

President Culbert then asked for a moment of silent prayer in memory of V. N. Welamb and Alexander McClintock, Sr., who had died since the last Chapter meeting.

President Culbert called upon M. F. Blankin to present resolutions on the death of Mr. McClintock. Mr. Blankin stated that J. D. Cassell had been associated with him in the preparation of the memorial resolutions and he asked Mr. Cassell as a life-time friend of Mr. McClintock to read them.

Afterwards, a motion was duly made and carried that a copy of these resolutions be spread upon the minutes and the secretary was instructed to send another copy to the members of Mr. McClintock's family.

Alex. McClintock, Jr., made a report on the program of the Membership Committee.

L. P. Hynes, chairman of the Membership Drive Committee for the Engineers Club, urged members of the Chapter to avail themselves of the opportunity of becoming members.

The general chairman of the Committee on Arrangements for the Summer Meeting at Buck Hill Falls, R. C. Bolsinger, reported on the arrangements for the meeting and stated that the excellent results were due to the energetic work of the various chairmen and their committee members. He also announced that $500.00 had been received from the Society to conduct this meeting and arrangements made it possible to return $75.00. Mr. Bolsinger read a letter of appreciation from the Society's Finance Committee in thanks for the unexpected refund and complimenting the Chapter on having planned one of the best Summer Meetings ever held.

A. C. Caldwell, chairman of the Meetings Committee, introduced T. N. Adlam, a former resident of England, who gave a very interesting talk on Panel Heating.

At the late hour of 11:00 p. m., W. G. R. Braemer tendered a vote of thanks to Mr. Adlam for his paper and the meeting was then adjourned. Owing to the illness of the secretary, W. R. Eichberg, the minutes were prepared by Mr. Blankin.

St. Louis

October 17, 1934. After dinner at Joe Garavelli's, DeBalivere and DeGiverville, Pres. Paul Sodemann called the meeting to order with 17 members and guests in attendance.

President Sodemann mentioned the recent visit to St. Louis of Nikolai Alfsen, of Oslo, Norway, a member of the Society. He then read a letter from the Bipartisan Advisory Board to the State Building Commission with regard to a meeting October 10 of interest to state engineers in certain branches of work.

J. W. Cooper, chairman of the Program Committee, outlined plans for future meetings and introduced J. L. DeNeille, president of the *Heating, Piping and Air Conditioning Contractors National Association,* who spoke on the NRA Code as it affects heating contractors and also outlined proposed means for making it effective locally. This talk was of much interest to those present and many questions were asked in connection with it.

A visomatic sound film on the Federal Housing Administration's program was shown and was followed by an interesting discussion.

A motion was made by J. M. Foster, seconded by J. W. Cooper, and carried that a standing committee be appointed by the president to represent the Chapter in cooperating with other agencies in the promotion of the FHA program. President Sodemann named J. M. Foster, *chairman,* E. A. White, and J. E. Hamilton for service on this committee.

Nominations for the Nominating Committee were in order. J. W. Cooper nominated and E. A. White seconded J. M. Foster as chairman of the Nominating Committee. E. A. White nominated and L. W. Moon seconded D. J. Fagin. L. W. Moon was nominated by D. J. Fagin and seconded by E. A. White. These three members were unanimously elected and President Sodemann appointed E. A. White and C. E. Hartwein to complete the personnel of this committee, according to the report of Secy. A. L. Walters.

CANDIDATES FOR MEMBERSHIP

The Constitution of the Society as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 53 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn the Council, urge the members to assume their share of the responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by December 15, 1934, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	*REFERENCES*	
	Proposers	*Seconders*
AIKEN, J. F., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
ALLAN, N. J., Asst. to Mgr., Kansas City Pump Co., Kansas City, Mo.	W. A. Russell N. W. Downes	J. H. Kitchen L. R. Chase
ANDERSON, S. H., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
ARCHER, DAVID M., Dist. Sales Repr., Sarco Co., Inc., Boston, Mass.	C. R. Swaney R. W. Cumming	T. N. Adlam F. H. Brigham
ARMSTRONG, R. W., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
AVERY, L. T., Pres., The Avery Eng. Co., Cleveland, Ohio.	M. F. Rather W. E. Stark	G. L. Tuve F. A. Kitchen
BARNUM, C. R., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
BUOT, A. V., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
BUTTS, R. L., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan

DAVISON, R. L., Director of Research, John B. Pierce Foundation, New York, N. Y.	W. R. Zuhlke R. E. Daly	F. B. Howell O. O. Oakes
DEWEY, R. P., Chief Engr., Barber-Colman Co., Rockford, Ill.	G. L. Larson C. J. Braatz	D. W. Nelson D. J. Stewart
DODGE, HARRY A., Elec. Engr., S. H. Kress & Co., New York, N. Y.	H. W. Fiedler J. O. Lennon	A. F. Hinrichsen S. A. S. Patorno
DODGE, HARRY G., Vice Pres., Metropolitan Pipe & Supply Co., Cambridge, Mass.	L. A. Brissette R. S. Franklin	A. Y. Christie J. J. Murray
DOVOLIS, N. J., Student, University of Minnesota, Minneapolis Minn.	F. B. Rowley A. B. Algren	J. V. Martenis G. C. Morgan
FITZGERALD, M. J., Treas. & Gen. Mgr., Standard Asbestos Mfg. Co., Chicago, Ill.	R. E. Hattis J. H. Milliken	J. R. Vernon C. W. DeLand
GELB, AMIEL, Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	J. V. Martenis G. C. Morgan
GILL, JOHN W., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
GORDON, W. J., JR., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
GREER, W. R., Air Cond. & Ill. Engr., Ark. Power & Light Co., Pine Bluff, Ark.	C. L. Toonder M. C. Terry *(Non-Member)*	F. W. Wilkes *(Non-Member)* R. E. Ritchie *(Non-Member)*
HAATVEDT, S. R., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
HASLETT, H. M., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
HAUSMAN, L. M., Pres. & Gen. Mgr., L. M. Hausman & Co., Manila, P. I.	E. R. Hyde *(A. S. C. E.)* Manual Felizardo *(A. S. M. E.)*	L. S. Eaton *(A. S. M. E.)* A. V. Tanco *(Non-Member)*
HOWARD, E. S., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
KNUDTSON, C. M., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
KOLINSKY, M. D., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
KUNS, J. W., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
LEDNUM, J. M., Chief Engr., Silica Gel Corp., Baltimore, Md.	S. R. Lewis Thornton Lewis	S. I. Rottmayer F. H. Wagner, Jr.
LUPIENT, G. C., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
MACCUBBIN, H. A., Htg. Contractor, H. A. Maccubbin, Inc., Baltimore, Md.	J. E. Axeman M. C. Gillett	L. W. McCrea L. G. Vance
MAYNARD, H. R., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
MCQUAID, D. J., Consulting Engr., Denver, Colo.	W. A. Russell K. F. Ebey *(Non-Member)*	S. F. Smith *(Non-Member)* H. D. Gregory *(Non-Member)*
MILLER, H. A., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
MJOLSNES, L. O., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
MYERS, C. R., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
NELSON, R. A., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
OSTRIN, ALBERT, Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
PABST, C. S., Pres. & Mgr., Adams Engrg. Co., Inc., New York, N. Y.	H. W. Fiedler André Merle	S. A. S. Patorno G. D. Fife
PAPPENFUS, W. G., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
POUCHER, R. C., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan

PUNG, D. W., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
ROSSITER, P. A., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
SHAW, H. W., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
SMOOT, T. H., Chief Engr., Fluid Heat Div., Anchor Post Fence Co., Baltimore, Md.	R. E. Daly C. W. Brabbée	Bernhard Goerg Bruce Hayter
STEINKELLNER, E. J., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
STRAUCH, P. C., Sales Engr., The Henry Furnace & Foundry Co., Pittsburgh, Pa.	T. F. Rockwell C. M. Humphrey	F. C. McIntosh F. C. Houghten
SWANSON, R. G., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
SWEATT, C. H., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	J. V. Martenis G. C. Morgan
SWEIVEN, C. E., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
TABOR, C. B., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
WETZELL, H. E., Chief Engr., The Smith & Oby Co., Cleveland, O.	M. F. Rather W. E. Stark	G. L. Tuve F. A. Kitchen
WHALLON, FLETCHER, Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
WHITSON, L. S., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan
WILLIS, L. L., Student, University of Minnesota, Minneapolis, Minn.	F. B. Rowley A. B. Algren	M. S. Wunderlich G. C. Morgan

Candidates Elected

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

MEMBERS

BRINKER, H. A., Member, Wilson-Brinker Co., Kalamazoo, Mich.
DAVIS, A. F., Vice Pres., The Johnson & Davis Plbg. & Htg. Co., Denver, Colo.
FABER, OSCAR, Consulting Engr., Bank of England, Westminster, London, S. W. 1, England.
MARTOCELLO, J. A., Pres., Jos. A. Martocello & Co., Philadelphia, Pa.
MERLE, ANDRÉ, Director of Engrg., Control Corp. of America, New York, N. Y.
O'REAR, L. R., Pres. Midwest Plbg. & Htg. Co., Denver, Colo.
REGER, H. P., Pres. & Treas., H. P. Reger & Co., Chicago, Ill.
RICE, R. B., Assoc. Prof. of Mech. Engrg., Newark College of Engrg., Newark, N. J.
WILLEY, E. C., Instructor, Oregon State College, Corvallis, Oregon.
WILSON, R. W., Partner, Wilson-Brinker Co., Kalamazoo, Mich.

ASSOCIATES

JORDAN, L. E., Engr., Minneapolis Air Conditioner Co., Minneapolis, Minn.
WALSH, J. A., Pres. & Treas., James A. Walsh, Inc., Philadelphia, Pa. (*Reinstatement.*)

STUDENTS

ALLMEN, N. S., Student, Case School of Applied Science, Cleveland Ohio.
BEARD, E. L., Student, University of Oklahoma, Norman, Okla.
BOWMAN, J. W., Student, University of Oklahoma, Norman, Okla.
BROOKS, F. W., Student, Case School of Applied Science, Cleveland, Ohio.
CHESNUTT, N. P., Student, University of Oklahoma, Norman, Okla.
COOK, A. B., Student, University of Oklahoma, Norman, Okla.
DAVIS, J. R., Student, Case School of Applied Science, Cleveland, Ohio.
DUGGER, E. R., Student, University of Oklahoma, Norman, Okla.
EMMONS, N. L., Student, University of Oklahoma, Norman, Okla.
FRAMPTON, A. C., Student, University of Oklahoma, Norman, Okla.
GEISSBUHLER, J. O., Student, Case School of Applied Science, Cleveland, O.
HOWLETT, I. G., Student, University of Oklahoma, Norman, Okla.
HUETTNER, H. F., Student, Carnegie Inst. of Tech., Pittsburgh, Pa.
HUSKY, S. T., Student, University of Oklahoma, Norman, Okla.
KALINSKY, A. G., Student, Case School of Applied Science, Cleveland, O.
KENNEDY, P. V., Student, Carnegie Inst. of Tech., Pittsburgh, Pa.
LOEFFLER, LOUIS, JR., Student, University of Oklahoma, Norman, Okla.
MARTINKA, P. D., Student, Case School of Applied Science, Cleveland, O.
MCKINLEY, C. B., Student, University of Oklahoma, Norman, Okla.
MINER, M. H., Student, University of Oklahoma, Norman, Okla.
PRENDERGAST, J. J., Student, Case School of Applied Science, Cleveland, O.
RAUH, E. M., Student, University of Oklahoma, Norman, Okla.
READ, R. R., Student, Case School of Applied Science, Cleveland, O.
REPKO, J. J., Student, Case School of Applied Science, Cleveland, O.
SCHMIDT, R. H., Student, Case School of Applied Science, Cleveland, O.
SENNET, L. E., Student, Case School of Applied Science, Cleveland, O.
SNEED, R. B., Student, University of Oklahoma, Norman, Okla.
SONNEY, K. J., Student, University of Oklahoma, Norman, Okla.
TAUSON, P. O., Student, University of Oklahoma, Norman, Okla.
WILHELM, J. E., Student, Case School of Applied Science, Cleveland, O.
WISE, D. E., Student, Case School of Applied Science, Cleveland, O.
YATES, GEORGE L., Student, University of Oklahoma, Norman, Okla.

Heating • Piping and Air Conditioning

January-December, 1934—Vol. 6, Nos. 1-12

As will be noted, these abstracts are classified under general heads. In searching for information on a specific subject, it will be well to look through the abstracts under the most suitable heading, and also to look through those under the other headings. For example, some of the heating articles also contain information on air conditioning, and vice versa, *as the grouping has been made on the basis of the subject most prominently covered in the article.*

The index to the Journal Section *of the* American Society of Heating and Ventilating Engineers *is separate* (*see page* 540).

This index does not include Interesting Equipment Developments; Book Reviews; Booklets, Reports, and Papers; Recent Trade Literature; and Conventions and Expositions, departments appearing regularly each month. The Editor's Page in each issue includes items of news, comments on current events, etc.

Air Conditioning

A Pioneer Study on Air Conditioning, by C. P. Yaglou.
Vol. 6. No. 5. May, 1934. *p.* 205.
(Review of "Some Psycho-Physics of Climate," by W. F. Tyler, a report of work done in 1902 in Shanghai); determination of scale of discomfort; relation to other research on comfort zones. (Illus.)

Air Conditioned Deposit Vault Proves Popular with Tenants.
Vol. 6. No. 5. May, 1934. *p.* 209.
Brief description of installation at Continental Safe Deposit Co., New York City. (Illus.)

Air Conditioned Humidor.
Vol. 6. No. 7. July, 1934. *p.* 288.
Brief description of air conditioned humidor at Dunhill shop, Rockefeller Center, New York City; capacity is 750,000 cigars.

Air Conditioner Saves Its Cost in First Carload of Tomatoes.
Vol. 6. No. 7. July, 1934. *p.* 301.
Air conditioner prevents drying out of tomatoes in ripening room; conditions maintained.

Air Conditioning Builds Business in Japan, by W. G. Hillen.
Vol. 6. No. 10. October, 1934. *p.* 429.
Advantages of air conditioning department stores and office buildings; typical installations in Japan; methods of air delivery to conditioned spaces. (Illus.)

Air Conditioning Existing Hospitals.
Vol. 6. No. 11. November, 1934. *p.* 471.
Review of report of American Hospital Association committee on air conditioning; advantages of air conditioning hospitals; cost; recommendations. (Illus.)

Air Conditioning in Hospitals.
Vol. 6. No. 10. October, 1934. *p.* 70 (*back section*).
(Answer to question); list of hospitals using air conditioning.

Air Conditioning in the Treatment of Pollen Asthma, by Tell Nelson, B. Z. Rappaport, A. G. Canar, and Wm. H. Welker.
Vol. 6. No. 8. August, 1934. *p.* 329.
Studies at College of Medicine of University of Illinois; dehumidifying and filtration apparatus used; silica gel dehumidification; special precautions with filter installation to remove pollen from air; results of the experiments; conclusions. (Illus.) See correction in issue of October, 1934, p. 430.

Air Conditioning Insures Purity Down on the Farm.
Vol. 6. No. 1. January, 1934. *p.* 16.
Room coolers installed in butter wrapping and storage rooms, Van Wert Butter Co., Van Wert, Ohio. (Illus.)

Air Conditioning Necessary in Any "Decently Constructed" Building, by F. J. Wilkins.
Vol. 6. No. 6. June, 1934. *p.* 256.
Opinion of building superintendent of air conditioned department store.

Air Conditioning of Libraries.
Vol. 6. No. 7. July, 1934. *p.* 302.
(Review of Bureau of Standards report); preventing damage to books and records from sulphur dioxide; effect of washing with treated and untreated water on sulphur dioxide content of library air; relation of sulphur dioxide content of washed air to hydrogen-ion content of wash water; importance of temperature and humidity; mildew; dust; condensation. (Illus.)

Air Conditioning Operating Cost Reduced by Efficient Use of Condensing Water, by George T. Condron.
Vol. 6. No. 10. October, 1934. *p.* 431.
Comparison of performance of steam jet refrigerating equipment; making efficient use of condensing water; combination of carbon dioxide and steam jet refrigeration for modernizing hotel air conditioning system; use of air precooler; diagrams of equipment layout; steam and condensing water consumption. (Illus.)

Air Conditioning Pays Its Way in Candy Stores.
Vol. 6. No. 3. March, 1934. *p.* 107.
Letter from Mrs. Snyder, operating thirteen candy shops in Chicago and suburbs, on advantages of air conditioning.

Air Conditioning Railway Passenger Cars.
Vol. 6. No. 3. March, 1934. *p.* 97.
Description of Union Pacific's high-speed, stream-lined three-car train "M-10000"; construction features; power plant; ducts integral with car structure; method of heating; operation of system when cooling; control of heating and air conditioning. (Illus.)

Air Conditioning System Does Two Jobs, by J. W. Baugher, Jr.
Vol. 6. No. 9. September, 1934. *p.* 394.
Air conditioned room for assembly and running-in of compressors at East Pittsburgh Works of Westinghouse Elec. & Mfg. Co.; cooling load; three suspended units cool room; one condensing units; location of equipment; fan and compressor control. (Illus.)

Alkaline Wash Water for Purification of Air.
Vol. 6. No. 10. October, 1934. *p.* 419.
Protecting against corrosion by maintaining alkalinity of air washer water.

Black Forest Climate Brought to Fair.
Vol. 6. No. 9. September, 1934. *p.* 396.
Brief description of refrigeration plant for ice skating rink and air conditioned restaurant at Black Forest Village, A Century of Progress Exposition, Chicago; direct expansion carbon dioxide for skating rink. (Illus.)

Choosing the Right Air Conditioning System, by A. Warren Canney.
Vol. 6. No. 11. November, 1934. *p.* 455.
(Part I—What Is the Proper Viewpoint?); the distinctive feature of air conditioning; significance of air conditioning; considerations in planning and air conditioning system; difference between industrial and comfort air conditioning; how compare air conditioning systems? (Illus.)

Choosing the Right Air Conditioning System, by A. Warren Canney.
Vol. 6. No. 12. December, 1934. *p.* 508.
(Part 2—Air Conditioning Methods, Equipment and the Problems They Present); objectives of an air conditioning system for comfort and the variations from them; discussion of the objectives; types of equipment and systems; classification of types of air conditioning systems represented by practice. (Illus.)

Coal Mine Installs New Fan—Saves $552 Each Month.
Vol. 6. No. 10. October, 1934. *p.* 424.
Brief report of savings made by modernization of ventilating equipment at Old Ben Coal Corp. mine. West Frankfort, Ill.

Consulting Engineer Surveys Theater Heating and Air Conditioning, by D. D. Kimball.
Vol. 6. No. 12. December, 1934. *p.* 497.
Survey of 76 motion picture theaters in eastern part of U. S.; classification of equipment found; discussion of results of survey—service and maintenance, periods of operation, records, use of equipment, wastes, competitive plans, radiation, boilers, heating systems, diagrams, temperature control; need for modernization.

Department of Justice Air Conditions Its New Building for Office Efficiency, by J. McHollan.
Vol. 6. No. 8. August, 1934. *p.* 332.
Three water-cooling units have 1950 ton capacity; compressors use freon; data on the refrigerating equipment; nine dehumidifier units; instruments; delivery of air to rooms; method of individual control for each room unit; problems in installation of the air delivery units. (Illus.)

Design and Construction of Modern Buildings Must Allow for Air Conditioning, by S. A. McGuire.
Vol. 6. No. 10. October, 1934. *p.* 423.
Importance of allowing for air conditioning in design and construction of modern buildings; examples; the modern building a "conditioned air factory." (Illus.)

86 Shops at Radio City Air Conditioned, by André Merle.
Vol. 6. No. 1. January, 1934. *p.* 12.
Method of air conditioning the shops in the R. C. A. Building, Rockefeller Center, New York City; air distribution system has four zones; control and recorders; pumps and cooling towers; automatic air compressors for control system; two 300-ton centrifugal compressors for refrigeration; duct insulation and machinery isolation. (Illus.)

Grocery Store Ups Sales and Profits by Air Conditioning.
Vol. 6. No. 10. October, 1934. *p.* 418.
Air conditioned chain grocery store of Jitney-Jungle, Inc., Jackson, Miss.; description of system; advantages of air conditioning this store. (Illus.)

Hospital Has Air Conditioned Rooms.
Vol. 6. No. 10. October, 1934. *p.* 430.
Illustration of air conditioning unit in room at Edgewater Hospital, Chicago. (Illus.)

Increased Air Conditioning Capacity with Economy, by R. D. Touton.
Vol. 6. No. 7. July, 1934. *p.* 285.
Alteration in manufacturing operations at central plant of Bayuk Cigars, Inc., Philadelphia, Pa., required additional air conditioning capacity; increased capacity obtained by off-peak compressor operation; offices and Cellophane wrapping machines increase refrigeration load; insulation and existing ducts simplify job; compressor and off-peak operation studied; storage tank for cooled water; other changes in system; results. (Illus.)

Industrial and Comfort Air Conditioning Equipment and Application Outline.
Vol. 6. No. 5. May, 1934. *p.* 201.
Elements of air conditioning and means for achieving them;

analysis of typical installations, showing relative importance of various features.

Industrial Fan Drive Applications—V-Belt, Flat Belt, Chain, by Robert W. Drake.
Vol. 6. *No.* 1. *January*, 1934. *p.* 17.
Possibilities for fan power savings by means of mechanical transmission equipment through control of speed; flat belt drives, idler drive, pivoted motor base; belt life; V-belt drives, advantages and limitations; advantages and limitations of chain drives; considerations in drive design. (Illus.)

Maintenance of the Air Conditioning Plant, by A. Warren Canney.
Vol. 6. *No.* 9. *September*, 1934. *p.* 373.
Checking and servicing an air conditioning plant at the end of the cooling season; running refrigeration plant intermittently; preheater bypass; shutting down refrigeration plant; the cooling tower; checking the heating equipment. (Illus.)

Modernizing with Air Conditioning, by Paul Sodemann.
Vol. 6. *No.* 5. *May*, 1934. *p.* 210.
Installation of comfort cooling system in Kline's department store, St. Louis, Mo.; units located in stock bins; ammonia from street main furnishes refrigeration; three types of outlets; location of the units; control of system; advantages. (Illus.)

More Comfort, Less Noise, Faster Operation.
Vol. 6. *No.* 6. *June*, 1934. *p.* 260.
Brief description of heating and ventilating new street car developed after three years of research. (Illus.)

Newer Methods of Brewing Beer Make Brewery Air Conditioning Essential.
Vol. 6. *No.* 5. *May*, 1934. *p.* 200.
Air conditioning system in Enterprise Brewery, Fall River, Mass., for supplying clean air to baudelot coolers and cool *pschipf*. (Illus.)

One Air Conditioning System Leads to Another, by Henry W. Moore.
Vol. 6. *No.* 6. *June*, 1934. *p.* 249.
Installation in ladies' ready-to-wear shop—Ellis Stone & Co., Greensboro, N. C.; advantages of air conditioning this shop.

One Fan Does Work of Two, by Milton K. Arenberg.
Vol. 6. *No.* 3. *March*, 1934. *p.* 101.
Hospital secures economical ventilation for two rooms by using siphon principle; location of blower and design details of installation; industrial applications of method. (Illus.)

Protecting Fans from Corrosion, by Francis A. Westbrook.
Vol. 6. *No.* 6. *June*, 1934. *p.* 256.
Brief report of metal spray process for protection from corrosion.

Psychrometric Charts for Air Conditioning, by Donald B. Brooks.
Vol. 6. *No.* 5. *May*, 1934. *p.* 216.
Chart and its basis explained, with examples of use; advantages. (Illus.)

The Public Utility Studies Air Conditioning.
Vol. 6. *No.* 5. *May*, 1934. *p.* 214.
(Review of "Air Conditioning Report to Client Companies," issued by Electric Bond and Share Company); promotion of air conditioning; advantages of air conditioning; rates and revenues; the air conditioning load; development of air conditioning; air conditioning demand, in kilowatts, for a bank, and office building, a hotel, a restaurant, and a department store. (Illus.)

Real Estate Firm Has Air Conditioned Offices.
Vol. 6. *No.* 1. *January*, 1934. *p.* 11.
Installation in offices of Frederick H. Bartlett & Company, Chicago. (Illus.)

Recent Developments in Sound Control and Their Importance in Air Conditioning, by Vern O. Knudsen.
Vol. 6. *No.* 6. *June*, 1934. *p.* 245.
Why noise reduction concerns air conditioning engineers; standardization of noise units; curves of equal loudness; relation between loudness sensation and loudness level; reducing noise transmitted through ducts; changing area of pipe or duct; temperature and humidity affect acoustics of large rooms. (Illus.)

Save in Air Conditioning Cost, by A. A. Browne.
Vol. 6. *No.* 8. *August*, 1934. *p.* 344.
Arrangement for reducing air conditioning cost with steam jet refrigeration where cool condenser water from deep well is available; the process of vacuum cooling; a cooling tower application and a deep well application compared; diagrammatic arrangement of system. (Illus.)

Selection of Motors for Air Conditioning, by Oliver S. Imes.
Vol. 6. *No.* 11. *November*, 1934. *p.* 467.
Description of St. Louis Municipal Auditorium; the air conditioning and heating systems; types of motors available for driving fans, pumps, filters, and other air conditioning equipment; selecting the proper motor; control of motors; tabulation of motors installed in the Auditorium. (Illus.)

Steam Jet Equipment at Rockefeller Center, by André Merle.
Vol. 6. *No.* 3. *March*, 1934. *p.* 111.
Size of installation and views of equipment. (Illus.)

Survey by Utility Company Shows 18,860 Tons Refrigeration for Air Conditioning in Chicago.
Vol. 6. *No.* 1. *January*, 1934. *p.* 11.
Types of installations, with tons refrigeration, compressor, fan, and pump horsepower.

Temperature and Humidity Requirements for Industrial Process Air Conditioning.
Vol. 6. *No.* 9. *September*, 1934. *p.* 386.
Table of temperature and humidity requirements for several products.

Water-Vapor Refrigeration—Steam Jet, by Paul Bancel.
Vol. 6. *No.* 3. *March*, 1934. *p.* 108.
The apparatus; diagram showing operation; capacity characteristics; operating characteristics; economy; reserve capacity; arrangement of weir-type evaporator; back-pressure characteristics of steam-jet booster. (Illus.)

Water-Vapor Refrigeration for Air Conditioning—the Centrifugal Compressor Unit, by Paul Bancel.
Vol. 6. *No.* 4. *April*, 1934. *p.* 164.
Development of centrifugal machine; operation; horsepower requirements; operating characteristics; reserve capacity; overload characteristics; applications of water vapor refrigeration—industrial processes and comfort air conditioning. (Illus.)

What's the Advantage of an Air Conditioned Office?
Vol. 6. *No.* 9. *September*, 1934. *p.* 393.
Advantages of air conditioning general office of International Business Machine Corp., Endicott, N. Y.

Windowless Construction Reduces Air Conditioning Load.
Vol. 6. *No.* 7. *July*, 1934. *p.* 292.
Brief description of new windowless department store of Sears, Roebuck & Co., Chicago, Ill.; completely air conditioned. (Illus.)

World's Fair Again Demonstrates Popularity of Air Conditioning.
Vol. 6. *No.* 6. *June*, 1934. *p.* 244.
Brief description of air conditioning installations at A Century of Progress, Chicago. (Illus.)

Heating

Alert Management, Meters, and Proper Control Cut Building Heating Costs, by Lester S. Ries.
Vol. 6. *No.* 7. *July*, 1934. *p.* 293.
How department of buildings and grounds at University of Chicago reduces steam consumption for heating; 119 flow meters show building steam consumption; use of meter records; how steam is saved; Walker Museum a typical case; temperature control saves 38 per cent. (Illus.)

Automatic Control System for 15 Unit Heaters, by K. E. Rockhold.
Vol. 6. *No.* 3. *March*, 1934. *p.* 106.
Unit heater installation at Central Market House, York, Pa.; 14 units supply 3,000,000 Btu per hr; the control system; diagram of control; reasons for installing system. (Illus.)

Bausch & Lomb Optical Company Modernizes Plant Heating, by Gray D. Dickason.
Vol. 6. *No.* 10. *October*, 1934. *p.* 415.
Steam consumption for heating Bausch & Lomb plant at Rochester, N. Y.; change-over to differential vacuum operation; central panel board for temperature control; zoning; unit heater control and operation; economies of modernization; operating records; steam consumption and degree days. (Illus.)

Bush Terminal Company Proves Wisdom of Modernizing Plant & Building Heating Systems, by Fred L. A. Schmidt.
Vol. 6. *No.* 9. *September*, 1934. *p.* 387.
Description of Bush Terminal Co. facilities, New York City; savings from modernizing heating system; the system before and after modernization; zoned orifice control; economic life of a heating system; 160,000 ft of pipe used in modernization work; organization of the work. (Illus.)

Electrical Power Industry Has Many Heating and Air Conditioning Problems, by Lee P. Hynes.
Vol. 6. *No.* 9. *September*, 1934. *p.* 382.
The hydro-electric generation of power; heat and humidity problems; how ice is combated; overcoming condensation troubles; dew-point control system to prevent condensation on surfaces; electric heating units; drying out electrical equipment; removing moisture from insulating oils. (Illus.)

Estimating Fuel Oil Consumption for Heating a Laundry Building.
Vol. 6. *No.* 7. *July*, 1934. *p.* 68 (*back section*).
(Answer by Samuel R. Lewis to question); typical example worked out.

Exhaust Steam Utilization Offers Economy to Plants and Buildings, by Perry West.
Vol. 6. *No.* 2. *February*, 1934. *p.* 49.
Utilization of exhaust steam promotes economy in space heating, air conditioning, drying, water heating, and process; general considerations and properties of steam; heat balance and adjustment of back pressures; uses of exhaust steam; exhaust steam for heating; studying heating loads and exhaust steam supply; heating, electric, hot water and refrigerating loads for hotel for winter, summer, and fall and spring months; similar curves for an office building, a manual training high school, and an apartment building; method of developing the curves; ideal steam consumption or water rates for steam turbines and engines; tables of efficiencies and factors for fractional loads; electrical consumption of various types of buildings. (Illus.)

Exhaust Steam Utilization Offers Economy to Plants and Buildings, by Perry West.
Vol. 6. *No.* 4. *April*, 1934. *p.* 169.
Heating requirements of buildings; balancing the loads; water heating loads; exhaust steam for drying and process; exhaust steam for air conditioning. (Illus.)

Gas-Fired Unit Heaters Solve Many Plant Heating Problems, by Herbert Chase.
Vol. 6. *No.* 8. *August*, 1934. *p.* 346.
Applications of gas-fired unit heaters in industrial plant heating; results achieved in a number of plants; considerations involved; control. (Illus.)

Heat Loss Through a Canvas Partition.
Vol. 6. *No.* 1. *January*, 1934. *p.* 6.
Question and Answer; method of calculating resistance to heat transmission of an inside canvas partition.

Heat Transfer in a Stainless-Steel Internal-Tube Milk Heater, by T. K. Sherwood.
Vol. 6. *No.* 2. *February*, 1934. *p.* 62.
Answer to specific question worked out in detail.

Heating and Air Conditioning Buildings with the Reversed Refrigeration Cycle, by C. F. Mowrey.
Vol. 6. *No.* 6. *June*, 1934. *p.* 257.
Reversed refrigeration cycle using gas-engine-driven compressor proposed; heating by means of the cycle; use of gas-engine-driven compressor; application of proposed layout to a warm air heating system; size of engine and compressor; possible control methods. (Illus.)

Heating and Air Conditioning Buildings with the Reversed Refrigeration Cycle, by C. F. Mowrey.
Vol. 6. *No.* 7. *July*, 1934. *p.* 295.
(Continued); application to warm air type of system, no recirculation; other methods of application; possible objections to method. (Illus.)

Heating Plant Check-Up Pays! by C. W. Kimball.
Vol. 6. *No.* 10. *October*, 1934. *p.* 426.
Consulting engineer investigates heating of hospital in Boston; modernization of the boiler plant; boilers are oil-fired; other modernization work; meters installed; severe winter proves investment in modernization sound; operating records show savings made. (Illus.)

Metallic Insulation, by A. F. Dufton.
Vol. 6. *No.* 2. *February*, 1934. *p.* 63.
Test set-up and method of conducting test for determining thermal conductivity of metallic insulation; results of tests.

Method of Installing the Panel Heating System in British Embassy Building.
Vol. 6. *No.* 7. *July*, 1934. *p.* 304.
(Answer by L. L. Munier to question); method of installation and insulation; principle of panel heating.

Modernize Means Profit to Many Apartment Buildings, by H. R. Coleman.
Vol. 6. *No.* 9. *September*, 1934. *p.* 377.
Reasons for modernizing apartment building heating systems; forced hot water heating system for Granada Court building, Portland, Ore.; shunt fittings installed at each radiator connection. (Illus.)

New Heating Plant of Radical Design, by B. R. Sheldon, with F. A. Westbrook.
Vol. 6. *No.* 11. *October*, 1934. *p.* 461.
Modernization of central heating plant for Mount Holyoke College, South Hadley, Mass.; reasons for modernization; new plant comprises 120 oil-fired boiler units; draft; central control of units; automatic cycling controls for buildings heated; maintaining water level in units. (Illus.)

New $3,800,000 Central Steam System Heats 42 Washington (D. C.) Buildings, by Pierce Timmis.
Vol. 6. *No.* 6. *June*, 1934. *p.* 250.
The plant design and location; maximum steam demand is 850,000 lb. per hr; the distribution system; welding the piping; normalizing the welds; integrating steam flow meters; metering in two stages; lighting the tunnels. (Illus.)

Oil-Fired Central Boiler Plant Modernizes Heating System for Five Apartment Buildings, by Albert E. Vroome.
Vol. 6. *No.* 5. *May*, 1934. *p.* 202.
Villa D'Est apartment group, near Philadelphia, Pa.; advantages of modernization of heating plant; two 175-hp oil-fired boilers; layout and insulation of piping; pumping units for returning condensate; installation of welded piping; hot water supply system; steam flow meters; operating records. (Illus.)

Operating Results with a Pulverized-Coal-Burning Plant, by Samuel R. Lewis and S. I. Rottmayer.
Vol 6. *No.* 1. *January*, 1934. *p.* 7.
New steam-generating plant installed for Chicago warehouses and offices of Jos. T. Ryerson & Son, Inc.; two-pipe steam-heating system with vacuum pumps; old boiler plant; new plant; boilers; breeching designed to separate fly ash; coal- and ash-handling equipment; auxiliary equipment and instruments; operating results show savings obtained; preventing steel in storage from rusting. (Illus.)

Placing Radiator on Inside Wall.
Vol. 6. *No.* 6. *June*, 1934. *p.* 253.
Answer by Samuel R. Lewis to question about advantages of placing radiator on inside or outside wall.

Plants and Buildings Modernize with Stokers.
Vol. 6. *No.* 8. *August*, 1934. *p.* 336.
Survey of advantages of several stoker installations in reducing heating cost, improving service and eliminating smoke. (Illus.)

Smoke Abatement in Hudson County, N. J.
Vol. 6. *No.* 3. *March*, 1934. *p.* 100.
Smoke abatement saves fuel users $531,000 in three-year period, reports Wm. G. Christy, smoke abatement engineer; methods of reducing smoke.

Split System for School Buildings.
Vol. 6. *No.* 10. *October*, 1934. *p.* 72 (back section).
(Answer by Platte Overton to question); calculation for heating school building by split system; ventilation requirements.

Stoker Firing Low Pressure Heating Plants, by Clint E. Beery.
Vol. 6. *No.* 4. *April*, 1934. *p.* 155.
Origin of underfeed stokers; coal a basic industry; high pressure and low pressure steam generating plants; stokers and boiler design; furnace design; the stoker as an investment; screw-feed and ram-type; coal for automatic coal burners; fly ash and its correction; smoke abatement; effect of varying ash percentage in coals; percentage of heating plant capacity to maintain 70 F. inside. (Illus.)

When Does Building Insulation Pay? by Paul D. Close.
Vol. 6. *No.* 12. *December*, 1934. *p.* 501.
Need for insulation in saving in cost of winter and summer air conditioning; economics of heat transfer; return on investment; diminishing return; optimum thickness of insulation; annual heat and insulation costs; special conditions; typical examples solved. (This article includes information from a paper presented at a meeting of the *Society for the Promotion of Engineering Education.*) (Illus.)

Piping

Alignment Chart for Solving Problems in Orifice Flow, by Allen S. Smith.
Vol. 6. *No.* 9. *September*, 1934. *p.* 392.
Equations upon which chart is based; construction and use of the chart. (Illus.)

Bibliography of Piping Information.
Vol. 6. *No.* 10. *October*, 1934, *p.* 433, and *Vol.* 6. *No.* 11. *November*, 1934. *p.* 78 (back section).
Listing of articles on piping published in Heating, Piping and Air Conditioning, May, 1929-November, 1934, inclusive.

Check Compressed Air Piping to Stop Waste, Excessive Cost, by A. W. Loomis.
Vol. 6. *No.* 9. *September*, 1934. *p.* 379.
Check-up is a paying proposition; location of intake piping; after-coolers and receivers; checking the piping; cost of steam, water and air leaks; other possible savings. (Illus.)

Computing the Thickness of Pipe, by Sabin Crocker.
Vol. 6. *No.* 2. *February*, 1934. *p.* 55.
(Article No. 2 on the Code for Pressure Piping); establishing the formula for use in computing safe thickness of pipe for any application in any of the several Code sections; the formula as worked out; values for *S* and *C*; water-hammer allowance for cast iron pipe; basis for allowable stress (*S* values); diversity of *S* and *C* values; maximum service temperature for various materials; explanation of Code paragraphs. (Illus.)

Corrosion of Piping—an Experience Report, by H. A. Ward.
Vol. 6. *No.* 9. *September*, 1934. *p.* 391.
Corrosion troubles in central plant heating system underground piping; corrosion in return lines due to trap discharge; method of correction. (Illus.)

Fabrication and Installation of the World's Largest Piping, by W. A. Cather.
Vol. 6. *No.* 8. *August*, 1934. *p.* 343.
Brief description of fabrication and installation of large piping for hydraulic power and outlet works tunnels at Boulder Dam. (Illus.)

Handling Process Materials that Require Melting, by Lee P. Hynes.
Vol. 6. *No.* 7. *July*, 1934. *p.* 289.
Amount of heat to supply; example (paraffin); local reheating of piping; cooling needed at certain points; piping and tanks must resist corrosion; construction details pictured. (Illus.)

How Does Increased Steam Pressure Affect Piping Maintenance? by W. H. Wilson.
Vol. 6. *No.* 2. *February*, 1934. *p.* 59.
Experience at one plant; expansion, contraction, gaskets, valves, insulation. (Illus.)

Identify Plant Pipe Lines to Save Time and Mistakes, by Robert W. Cuthill.
Vol. 6. *No.* 4. *April*, 1934. *p.* 168.
Piping identification chart and instructions as used at Naval Aircraft Factory, Philadelphia, Pa. (Illus.)

Industrial Process Piping—Welding and Brazing Joints and Connections of Industrial Vessels, by Lee P. Hynes and W. Schoeni.
Vol. 6. *No.* 11. *November*, 1934. *p.* 463.
Recommendations for welding practice—steel, nickel and monel, aluminum, stainless steel, everdur, brass and copper; welding jacketed vessels; special fittings for welding; details of various types of joints and connections. (Illus.)

Insulating Steam Line Supports and Anchors.
Vol. 6. *No.* 10. *October*, 1934. *p.* 70 (back section).
(Answer by Robert L. Fitzgerald to question); sketch and description of method of insulating underground steam line supports and anchors with rock wool. (Illus.)

Methods of Installing Refrigeration Piping, by Robert S. Wheaton.
Vol. 6. *No.* 12. *December*, 1934. *p.* 512.
Installation of refrigeration piping in winter ice storage rooms; practice; installing coils in brewery beer storage rooms; method of making double offset to avoid obstructions. (Illus.)

Mine Modernizes Pump Control.
Vol. 6. *No.* 2. *February*, 1934. *p.* 64.
Copper mine saves $10,000 per year by improving pump control equipment.

The New Code for Pressure Piping, by Sabin Crocker.
Vol. 6. *No.* 1. *January*, 1934. *p.* 1.
Proposed American Standard Code for Pressure Piping; need and inception of code; committee organization and historical sketch; scope, content, and plan; Section I—Power Piping; materials; dimensional standards for flanges and fittings; valves; reducing and relief valves; bolting; pipe threads; pipe joints; gaskets; thermal expansion; hangers, supports, and anchors; pipe sleeves; drips, drains, and steam traps; inspection, tests, and cleaning; table of hydrostatic tests for steel fittings and valves. (Illus.)

New Pressure Piping Code Reviewed, by Sabin Crocker.
Vol. 6. *No.* 5. *May*, 1934. *p.* 207.
Requirements for gas and air piping systems; extracts from Section 2 of Code; district heating distribution systems; extracts from Section 4 of Code. (Illus.)

New Pressure Piping Code Reviewed, by Sabin Crocker.
Vol. 6. *No.* 6. *June*, 1934. *p.* 254.
Review and explanation of section on fabrication details; hangers, supports, etc.; expansion and flexibility; thermal expansion of piping materials.

Oil Piping Systems, by Sabin Crocker.
Vol. 6. *No.* 3. *March*, 1934. *p.* 102.
Section 3 of Code for Pressure Piping, covering oil piping systems for production, transmission and refining of petroleum; requirements for oil piping; materials; thickness of wrought pipe; thickness of cast iron pipe; summary of requirements and recommendations for oil piping systems; service oil pressure ratings for carbon steel valves and fittings, and for chrome-nickel or equivalent alloy steel valves and fittings. (Illus.)

Oil Piping Systems for Production, Transmission and Refining of Petroleum, by Sabin Crocker.
Vol. 6. *No.* 4. *April*, 1934. *p.* 161.
(Review of Code for Pressure Piping, continued); valves; joints, flanges and fittings; miscellaneous requirements. (Illus.)

Piping and Pumping Molasses for Industrial Process Uses, by Lee P. Hynes.
Vol. 6. *No.* 5. *May*, 1934. *p.* 197.
How molasses is obtained; uses; unloading from tankers; viscosity of black strap molasses; handling molasses at the plant; selecting pumps and motors; pumping molasses to process tank; heating. (Illus.)

Carbon Dioxide Gas in Molasses Complicates Piping and Pumping by Wm. E. Worcester.
Vol. 6. *No.* 9. *September*, 1934. *p.* 381.
(Comment on "Piping and Pumping Molasses" in May, 1934, issue); allowing for carbon dioxide gas in molasses and importance of so doing.

Flow and Pressure Drop Calculations for Process Piping, by Emory Kemler.
Vol. 6. *Nos.* 1-5. *January-May*, 1934.
Series of charts to facilitate making pressure crop calculations for liquids of various kinematic viscosities flowing in pipe of different sizes; chart for ¾ in. pipe in January, 1934, issue, p. 21; chart for ½ in. in March, 1934, issue, p. 114; chart for ¼ in. in May issue, p. 213; chart for ⅜ in. in April issue, p. 172; see explanation of use of charts in October, 1933, issue.

Piping at High Temperatures, by E. W. Norris.
Vol. 6. *No.* 10. *October*, 1934. *p.* 420.
Behavior of steel at high temperatures; creep; piping for 650 lb. and 850 F. at Buzzard Point, Washington, D. C.; design of connections; method of testing; face-to-face flange pressure; seal-welding of flanges; gaskets; results of tests on connections. (Illus.)

Piping Layout and Steam Pressure Control in Steam Generating Plants, by E. C. Gaston.
Vol. 6. *No.* 12. *December*, 1934, *p.* 506.
Need for careful attention to location of control; variation of steam pressure in piping; loss in superheater; typical example. (Illus.)

Piping That's Clean Is Brewery Requirement, by Daniel T. O'Neil and Waldemar Mortensen (as told to Francis A. Westbrook).
Vol. 6. *No.* 3. *March*, 1934. *p.* 112.
Harvard Brewery, Lowell, Mass., reconditioned; new pipe line from stockhouse to government tanks of seamless copper tubing; arrangements for cleaning; special lock fitting. (Illus.)

Prefabrication of Welded Piping for the Buzzard Point Plant, by A. W. Moulder.
Vol. 6. *No.* 6. *June*, 1934. *p.* 241.
Description of plant; 730 lb. steam pressure and 835 F. total steam temperature; the piping; value of welded construction;

reasons for prefabrication; refinement in design; details of method of installing and prefabricating the piping. (Illus.)

Production Methods in Pipe Welding for Plant Construction, by G. E. Deatherage and J. B. Latterner.
Vol. 6. *No.* 12. *December*, 1934. *p.* 500.
(From a paper presented at 1934 meeting of *International Acetylene Assn.*); organization and method of installing welded piping during construction of industrial plants.

Pump Capacity Increased by Piping Change, by N. T. Pef.
Vol. 6. *No.* 7. *July*, 1934. *p.* 301.
Importance of piping layout in saving energy required for pumping; typical example shows savings. (Illus.)

Requirements for Welded Piping Joints, by Sabin Crocker.
Vol. 6. *No.* 7. *July*, 1934. *p.* 298.
(Review of Code for Pressure Piping); methods for securing sound welds; qualification tests of welders; summary of code requirements for welded joints of piping and pressure vessels; check tests of welds; stress relieving welds; alignment for welding. (Illus.)

Requirements for Welded Piping Joints, by Sabin Crocker.
Vol. 6. *No.* 8. *August*, 1934. *p.* 339.
Review of Code for Pressure Piping requirements for welded piping joints; details of various types of welds and test specimens; qualification tests for welders; extracts from the Code requirements. (Illus.)

Steam Booster Compressors Simplify Piping, by C. G. Kohl.
Vol. 6. *No.* 10. *October*, 1934. *p.* 425.
Practical applications of steam booster compressors for supplying small quantities of higher pressure steam; features of this equipment. (Illus.)

Unloaders Relieve Pressure on Pistons for Automatic Compressor Starting, by Terry Mitchell.
Vol. 6. *No.* 2. *February*, 1934. *p.* 60.
Refrigeration system for maintaining ten storage rooms at different temperatures at Willard State Hospital, Willard, N. Y.; operation of various types of unloaders, ammonia and low-pressure brine cut-outs; signal lights show action of protective devices; diagram of control board for compressor units. (Illus.)

Use of Pipe for Piling.
Vol. 6. *No.* 5. *May*, 1934. *p.* 206.
Description of use of pipe for driving piling for building foundations, etc.

Welding Non-Ferrous Process Piping, by G. E. Deatherage.
Vol. 6. *No.* 1. *January*, 1934. *p.* 14.
Use of oxy-acetylene blowpipe in chemical and other process industries; choice of piping material, rod and flux; description of a typical aluminum and a copper piping system at a chemical plant, with explanation of fabrication methods, joining sweat-type copper fittings, testing, etc. (Illus.)

Journal of American Society of Heating and Ventilating Engineers

January—December, 1934—Vol. 6, Nos. 1-12

Admiral Reeves Addresses Engineers at New York, Sept. 411
Air Conditioning in Its Relation to Human Welfare, C. A. Mills, Apr. 175
Air Conditioning System of the New Metropolitan Building—First Summer's Experience, The, W. J. McConnell and I. B. Kagey, June 274
American Engineering Council Meeting Dates, Dec. 530
Anderson Taken by Death, Dean, May 238
Annual Meeting, 41st, Nov. 491
A. S. A. Advisory Committee, Sept. 407
A. S. A. Standard for Lantern Slide Charts, July 314
A. S. H. V. E. Standard Code for Testing and Rating Return Line Low Vacuum Heating Pumps, Mar. 136
A. S. H. V. E. Summer Meeting June 20-21-22, June 281
A. S. H. V. E. Booth at Power Show, Dec. 530
A.S.M.E. Domestic Heating Session, Dec. 530
A.S.M.E. Medal Awarded to W. H. Carrier, Dec. 530
A. S. R. E. 30th Annual Meeting, Dec. 531
Beals, A. E., Dry Bulb vs. Effective Temperature Control, July 315
Benjamin, L. C., C. P. Yaglou and, Diurnal and Seasonal Variations in the Small-Ion Content of Outdoor and Indoor Air, Jan. 25
Blackshaw, J. L., and Carl Gutberlet, F. C. Houghten, Wind Velocities Near a Building and Their Effect on Heat Loss, Sept. 399
Blackshaw, J. L., F. C. Houghten, Carl Gutberlet, and, Studies of Solar Radiation Through Bare and Shaded Windows, Feb. 67
Bloomfield, J. J., Criteria for Industrial Exhaust Systems, July 319
Bon Voyage, Nov. 482
Brabbée, C. W., Design and Valuation of Cast Iron Domestic Heating Boilers, May 223
Broderick, E. L., A. P. Kratz, M. K. Fahnestock and, Factors Affecting the Heat Output of Convectors, July 307
Buffalo Prepares for 1935, Sept. 411
Burt, B. F., and S. R. Lewis, Heating Buildings with Hot Water, Apr. 180
Calvin Rice, Secretary of A.S.M.E., Dies, Dec. 526
Candidates Elected, Jan. 48
Feb. 96
Mar. 154
Apr. 196
May 240
June 284
July 328
Aug. 372
Sept. 414
Oct. 454
Nov. 496
Dec. 536
Candidates for Membership, Jan. 47
Feb. 96
Mar. 153
Apr. 195
May 239
June 284
July 328
Aug. 371
Sept. 414
Oct. 453
Nov. 495
Dec. 534
Chapter Reports, Jan. 43, 45, 46
Feb. 74, 93
Mar. 148, 149, 150, 151, 152
Apr. 194, 195
May 234, 235
June 273
July 324, 325, 326
Aug. 368, 369, 370, 371
Sept. 411, 412
Oct. 445, 449, 450, 451, 452
Nov. 492, 493, 494
Dec. 531, 532, 533, 534
Chemical Engineers' Handbook, Apr. 179
Classification of Coals, July 318
Code Authority of Air Valve Industry, Oct. 440
Code Authority Memberships Recognized, Dec. 531
Code Conference Called, Mar. 123
Comfort Cooling with Attic Ventilating Fans, G. B. Helmrich and G. H. Tuttle, Feb. 85
Committee on Research, Aug. 364
Committees Appointed for Annual Meeting, Oct. 449
Congratulations, Colonel, Nov. 489
Consulting Offices Opened in New York and Hempstead, Sept. 411
Consumers Board Asks Uniform Grade Names, Oct. 440
Corrosion Studies in Steam Heating Systems, R. R. Seeber, F. A. Rohrman and G. E. Smedberg, Mar. 124
(Cooperative Research Paper.)
Council Meeting, The, Aug. 364
Council Members Who Take Office in 1934, Mar. 144
Criteria for Industrial Exhaust Systems, J. J. Bloomfield, July 319
Croft, H. O., and T. R. Thoren, The Ventilating Effect of a Slotted Cylinder, Oct. 441
Daly, John H., June 278
Deaths
Daly, J. H., June 278
Hankin, Richard, Jan. 43
McClintock, Sr., Alexander, Nov. 495
McKenna, W. N., Mar. 153
Rice, Calvin, Dec. 526
Swan, J. A., Apr. 195
Welamb, V. N., July 327
Wilson, H. A., Sept. 412
Zeck, Alexander, Oct. 445
DeNeille Elected President of Heating Contractors, July 327
Design and Equipment of the Pierce Laboratory, C.-E. A. Winslow, Leonard Greenburg, L. P. Herrington and H. G. Ullman, Mar. 127
Design and Valuation of Cast Iron Domestic Heating Boilers, C. W. Brabbée, May 223
Directory of Engineering Societies and Associations, Dec. 519
Directs Sales of Air Conditioning Equipment, Dec. 530
Diurnal and Seasonal Variations in the Small-Ion Content of Outdoor and Indoor Air, C. P. Yaglou and L. C. Benjamin, Jan. 25
(Cooperative Research Paper.)
Drewry, M. K., Low-Cost Air Conditioning for a Small Residence, Jan. 33
Drinker, Philip, and W. F. Wells, A Method of Testing Filters Against Pollens, Bacteria and Molds, Sept. 408
Dry Bulb vs. Effective Temperature Control, A. E. Beals, July 315
Eichberg Returns to Office, W. R., Dec. 530
Echoes of Buck Hill, Sept. 411
Educational Activities of the St. Louis Chapter, Paul Sodemann, Dec. 524
Electrical Engineers Elect Officers, Aug. 371
Engineering Courses at Polytechnic, Oct. 449
Engineering in the Hospital of Tomorrow, C. F. Neergaard, May 229
Estep, Thos. G., Some Recent Studies on the Ashes in Coal, Dec. 520
Everetts, Jr., John, What Is the Cooling Load Factor in Air Conditioning? Sept. 405
Exhibitors in Third International Heating and Ventilating Exposition, Feb. 94
Factors Affecting the Heat Output of Convectors, A. P. Kratz, M. K. Fahnestock and E. L. Broderick, July 307
(Cooperative Research Paper.)
Fahnestock, M. K., and E. L. Broderick, A. P. Kratz, Factors Affecting the Heat Output of Convectors, July 307
Fahnestock, M. K., and S. Konzo, A. P. Kratz, Study of Unit Room Coolers in the Research Residence, Nov. 483

Federal Better Housing Program, Sept. 413
Fun at Buck Hill Falls, Aug. 366
Fun in Little Old New York, Mar. 147
Furnace Manufacturers Mid-year Meeting, July. 327
Furnace Manufacturers Visit Laboratory, Dec. 531
Girl Who Came Back, The, Oct. 448
Goff, J. A., Thermodynamic Properties of Moist Air, Mar. 117
Going to Buffalo? Dec. 528
Greenburg, Leonard, L. P. Herrington, and H. G. Ullman, C.-E. A. Winslow, Design and Equipment of the Pierce Laboratory, Mar. 127
Guide Publication Committee Meets, Aug. 364
Guide, The 12th Edition of the A. S. H. V. E., Feb. 93
Gutberlet, Carl, and J. L. Blackshaw, F. C. Houghten, Studies of Solar Radiation Through Bare and Shaded Windows, Feb. 67
Gutberlet, Carl, F. C. Houghten, J. L. Blackshaw and, Wind Velocities Near a Building and Their Effect on Heat Loss, Sept. 399
Hankin Dies, Richard, Jan. 43
Harrington, Elliott, and L. A. Mears, A Proving Home for Air Conditioning Investigations, Apr. 185
Heat Requirements of Buildings, The, J. H. Walker and G. H. Tuttle, Dec. 515
Heat Transfer from Direct and Extended Surfaces with Forced Air Circulation, G. L. Tuve and C. A. McKeeman, June 267
(Cooperative Research Paper.)
Heat Transfer Teaching Course, June. 266
Heating Buildings with Hot Water, B. F. Burt and S. R. Lewis, Apr. 180
Helmrich, G. B., and G. H. Tuttle, Comfort Cooling with Attic Ventilating Fans, Feb. 85
Herrington, L. P. and H. G. Ullman, C.-E. A. Winslow, Leonard Greenburg, Design and Equipment of the Pierce Laboratory, Mar. 127
Hertzler, J. R., Operating Results of an Air Conditioning System Compared with Design Figures, Aug. 354
Holden, T. S., Re-Employment of the Construction Industry, Aug. 361
Houghten, F. C., J. L. Blackshaw and Carl Gutberlet, Wind Velocities Near a Building and Their Effect on Heat Loss, Sept. 399
Houghten, F. C., Carl Gutberlet and J. L. Blackshaw, Studies of Solar Radiation Through Bare and Shaded Windows, Feb. 67
Influence of Stack Effect on the Heat Loss in Tall Buildings, Axel Marin, Aug. 349
(Cooperative Research Paper.)
Insulating Value of Bright Metallic Surfaces, F. B. Rowley, June 263
(Cooperative Research Paper.)
Italian Member Returns to Milan, Aug. 364
James, John, G. L. Larson, D. W. Nelson, and, Tests of Three Heating Systems in an Industrial Type of Building, Nov. 475
June Meeting in the Mountains, May. 236
Kagey, I. B., W. J. McConnell and, The Air Conditioning System of the New Metropolitan Building—First Summer's Experience, June 274
Kendall, T. A., and Garland Weidner, Observations of Hay-Fever Sufferers in Air-Conditioned Room and the Relationship Between the Pollen Content of Outdoor Air and Weather Conditions, Feb. 75
Konzo, S., A. P. Kratz, M. K. Fahnestock, and, Study of Unit Room Coolers in the Research Residence, Nov. 483
Kratz, A. P., M. K. Fahnestock and E. L. Broderick, Factors Affecting the Heat Output of Convectors, July 307
Kratz, A. P., M. K. Fahnestock, and S. Konzo, Study of Unit Room Coolers in the Research Residence, Nov. 483
Larson, G. L., D. W. Nelson, and John James, Tests of Three Heating Systems in an Industrial Type of Building, Nov. 475
Lewis, S. R., B. F. Burt and, Heating Buildings with Hot Water, Apr. 180
Loeb, L. B., The Nature of Ions in Air and Their Possible Physiological Effects, Oct. 437
Low-Cost Air Conditioning for a Small Residence, M. K. Drewry, Jan. 33
Manufacturers of Unit Air Conditioners Organize, Sept. 413
Marin, Axel, Influence of Stack Effect on the Heat Loss in Tall Buildings, Aug. 349
McClintock, Sr., Death of Alexander, Nov. 495
McConnell, W. J., and I. B. Kagey, The Air Conditioning System of the New Metropolitan Building—First Summer's Experience, June 274
McDermott with J. M. Laboratory, Paul, July. 326
McKeeman, C. A., G. L. Tuve and, Heat Transfer from Direct and Extended Surfaces with Forced Air Circulation, June 267
McKenna Dies, William N., Mar. 153
Mears, L. A., Elliott Harrington and, A Proving Home for Air Conditioning, Investigations, Apr 185
Method of Choosing Location of, Financing and Conducting Meetings of the Society, Jan. 40
June 279
Method of Testing Filters Against Pollens, Bacteria and Molds, A, Philip Drinker and W. F. Wells, Sept. 408
Mills, C. A., Air Conditioning in Its Relation to Human Welfare, Apr. 175
Modernize If Return Justifies, Aug. 353
Modernizing Program Starts Under FHA, Oct. 448
Nature of Ions in Air and Their Possible Physiological Effects, The, L. B. Loeb, Oct. 437
Neergaard, C. F., Engineering in the Hospital of Tomorrow, May 229
Nelson, D. W., and John James, G. L. Larson, Tests of Three Heating Systems in an Industrial Type of Building, Nov. 475
New Code Authority Membership Announced, July. 327
New York Extends a Hearty Welcome, Jan. 41
Nominations for 1934, Jan. 44
Nominations for 1935, Oct. 446
Nov. 490
Dec. 527
NRA Codes, Jan. 32
Observations of Hay-Fever Sufferers in Air-Conditioned Room and the Relationship Between the Pollen Content of Outdoor Air and Weather Conditions, T. A. Kendall and Garland Weidner, Feb. 75
Of Interest to Members, Oct. 449
Officers Elected in 1934, Mar. 143
Operating Results of an Air Conditioning System Compared with Design Figures, J. R. Hertzler, Aug. 354
Proceedings of the 40th Annual Meeting, Mar. 132
Proceedings of the Semi-Annual Meeting 1934, Aug. 359
Program, Annual Meeting 1934, Jan. 42
Feb. 95
Program, 41st Annual Meeting, Dec. 529
Program Semi-Annual Meeting 1934, June. 279
Proving Home for Air Conditioning Investigations, A, Elliott Harrington and L. A. Mears, Apr. 185
Re-Employment of the Construction Industry, T. S. Holden, Aug. 361
Report of Committee on Research, Feb. 89
Report of Council, Mar. 134
Report of Finance Committee, Mar. 135
Report of Guide Publication Committee, Mar. 139
Report of Membership Committee, Mar. 139
Report of President, Mar. 132
Report of Publication Committee, Mar. 140
Report of Secretary, Mar. 134
Report of Tellers, Mar. 135
Rice, Secretary of A. S. M. E., Dies, Calvin, Dec. 526
Rohrman, F. A., and G. E. Smedberg, R. R. Seeber, Corrosion Studies in Steam Heating Systems, Mar. 124
Rowley, F. B., Insulating Value of Bright Metallic Surfaces, June 263
Second Edition of Refrigerating Data Book Published, Nov. 489
Seeber, R. R., F. A. Rohrman and G. E. Smedberg, Corrosion Studies in Steam Heating Systems, Mar. 124
Seeley, L. E., and E. J. Tavanlar, Study of Fuel Burning Rates and Power Requirements of Oil Burners in Relation to Excess Air, May. 219
Silicosis Reference Volume Issued, Aug. 358
Smedberg, G. E., R. R. Seeber, F. A. Rohrman and, Corrosion Studies in Steam Heating Systems, Mar. 124
Smoke Abatement Exhibit to be Continued, Dec. 530
Smoke Prevention Association Elects Officers, Sept. 413
Society Goes Around the World, The, Oct. 447
Sodemann, Paul E, Educational Activities of the St. Louis Chapter, Dec. 524
Some Recent Studies on the Ashes in Coal, Thos. G. Estep, Dec. 520
S.P.E.E. Committee on Engineering Research, Dec. 530
Standards Specified by NRA Codes, Sept. 413
Studies of Solar Radiation Through Bare and Shaded Windows, F. C. Houghten, Carl Gutberlet, and J. L. Blackshaw, Feb. 67
(Research Laboratory Paper.)
Study of Fuel Burning Rates and Power Requirements of Oil Burners in Relation to Excess Air, L. E. Seeley and E. J. Tavanlar, May. 219
(Cooperative Research Paper.)
Study of Unit Room Coolers in the Research Residence, A. P. Kratz, M. K. Fahnestock, and S. Konzo, Nov. 483
(Cooperative Research Paper.)
Summer Meeting in the Pocono Mountains, Apr. 194
Survey of Engineering Profession Announced, Dec. 530
Swan, Death of James A., Apr. 195
Tapp Assumes New Duties, H. F., Dec. 530
Tavanlar, E. J., L. E. Seeley and, Study of Fuel Burning Rates and Power Requirements of Oil Burners in Relation to Excess Air, May. 219
Tests of Three Heating Systems in an Industrial Type of Building, G. L. Larson, D. W. Nelson and John James, Nov. 475
(Cooperative Research Paper.)
Thermodynamic Properties of Moist Air, J. A. Goff, Mar. 117
Third Heating and Ventilating Exposition, Jan. 43
Mar. 145
Thoren, T. R., H. O. Croft and, The Ventilating Effect of a Slotted Cylinder, Oct. 441
Three Codes Approved by Members, Aug. 353
Tuttle, G. H., G. B. Helmrich and, Comfort Cooling with Attic Ventilating Fans, Feb. 85
Tuttle, G. H., J. H. Walker and, The Heat Requirements of Buildings, Dec. 515
Tuve, G. L., and C. A. McKeeman, Heat Transfer from Direct and Extended Surfaces with Forced Air Circulation, June 267
Twenty Years with Chicago School System, Jan. 32
Ullman, H. G., C.-E. A. Winslow, Leonard Greenburg, L. P. Herrington and, Design and Equipment of the Pierce Laboratory, Mar. 127
Ventilating Effect of a Slotted Cylinder, The, H. O. Croft and T. R. Thoren, Oct. 441
Walker, J. H., and G. H. Tuttle, The Heat Requirements of Buildings, Dec. 515
Weidner, Garland T. A. Kendall and, Observations of Hay-Fever Sufferers in Air Conditioned Room and the Relationship Between the Pollen Content of Outdoor Air and Weather Conditions, Feb. 75
Welamb Dies, Victor N., July. 327
Wells, W. F., Philip Drinker and, A Method of Testing Filters Against Pollens, Bacteria and Molds, Sept. 408
What Is the Cooling Load Factor in Air Conditioning? John Everetts, Jr., Sept. 405
Willard, President of University of Illinois, A. C., Apr. 193
Wilson, Death of Harry A., Sept. 412
Wind Velocities Near a Building and Their Effect on Heat Loss, F. C. Houghten, J. L. Blackshaw and Carl Gutberlet, Sept. 399
(Research Laboratory Paper.)
Winslow, C.-E. A., Leonard Greenburg, L. P. Herrington and H. G. Ullman, Design and Equipment of the Pierce Laboratory, Mar. 127
Yaglou, C. P., and L. C. Benjamin, Diurnal and Seasonal Variations in the Small-Ion Content of Outdoor and Indoor Air, Jan. 25
Zeck, Alexander, Oct. 445

IN THE NEWS • • • •

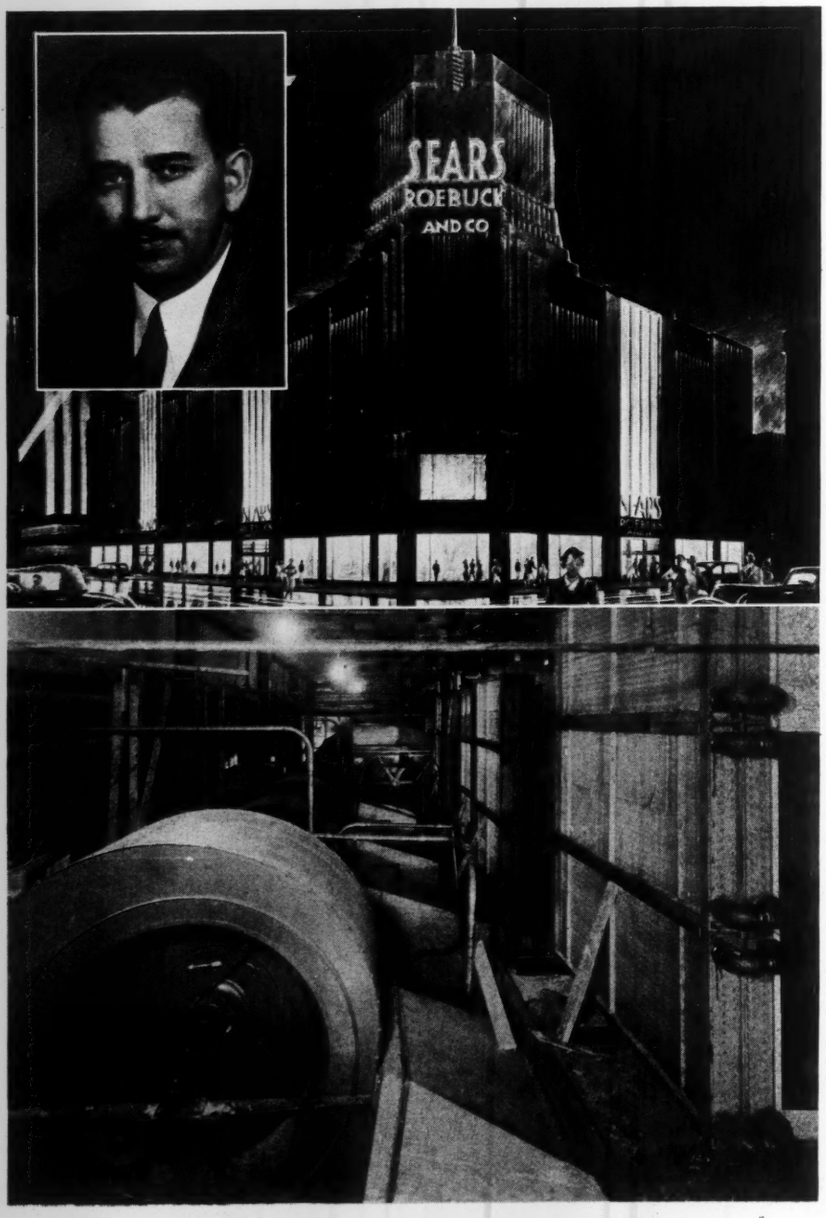
. . . . NEW AIR CONDITIONED DEPARTMENT STORE OF WINDOWLESS CONSTRUCTION

COMPLETELY air conditioned and of unique windowless construction is the new Sears, Roebuck & Company department store at 63rd and Halsted streets on Chicago's south side. Capacity crowds attended its formal opening last month.

Refrigeration—a total of 501 tons—for air conditioning the four sales floors and the basement is supplied by two centrifugal water vapor machines, one having a capacity of 334 tons and driven by a 350 hp motor, and the other with a capacity of 167 tons and driven by a 200 hp motor. The centrifugal units run at 7500 rpm, the motors at 1750 rpm. General offices on the fifth floor are cooled by a separate refrigerating unit and duct system.

Of the 501 tons refrigeration capacity only 46 tons are required to cool the structure itself, the balance being necessary for fresh air for ventilation, the lighting load, and the people (5,000 persons used in calculations). The total conditioned air supply is 2,000 cfm, which is two to four times as much as required by city ordinances, according to M. G. Harbula, who furnishes the information given here.

The air is conditioned in the summer by means of fin type cooling coils through which chilled water (50-63 degrees) is circulated. City water is used in early and late summer to save an estimated 27 per cent in operating cost. Part of the same coils used for chilled water circulation in summer are used for steam in winter.



(Top)—Artist's conception of the windowless Sears, Roebuck department store, Chicago, which was opened last month. . . . (Bottom)—View of the supply fans taken during construction before partitions were installed between each unit. Each fan supplies one-half a floor, except that the basement has one fan. It is over 100 ft from the first fan to the one seen in the background. . . . (Inset)—M. G. Harbula, advisory engineer for Sears, Roebuck & Co. on the air conditioning for this building

SQUIBB plant engineer avoids PIPE TROUBLE with...

BYERS WROUGHT IRON

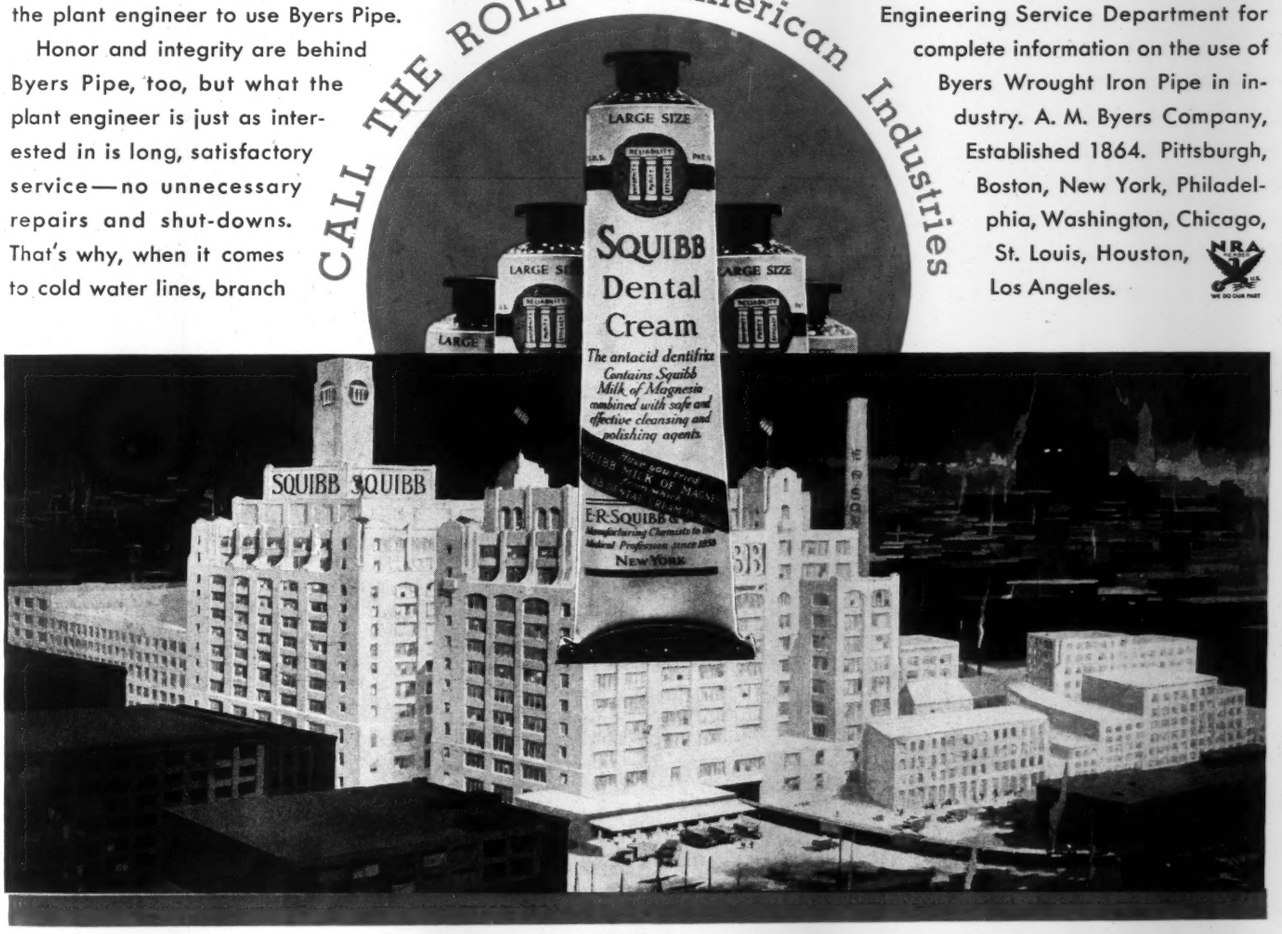
WHEREVER you find high standards of manufacture there you will also find high standards in equipment.

Consequently, in the SQUIBB Plant where "the priceless ingredient of every product is the honor and integrity of its maker," it is only natural for the plant engineer to use Byers Pipe.

Honor and integrity are behind Byers Pipe, too, but what the plant engineer is just as interested in is long, satisfactory service—no unnecessary repairs and shut-downs. That's why, when it comes to cold water lines, branch waste and vent lines; gas, steam supply and return lines and certain process lines the SQUIBB Plant engineer specifies Wrought Iron Pipe.

Would you be interested in how other leading plant engineers use Byers Wrought Iron Pipe for their corrosive lines including refrigeration? Our records of the use of Byers Pipe in industry leave no doubt as to where it gives longer life and freedom from trouble.

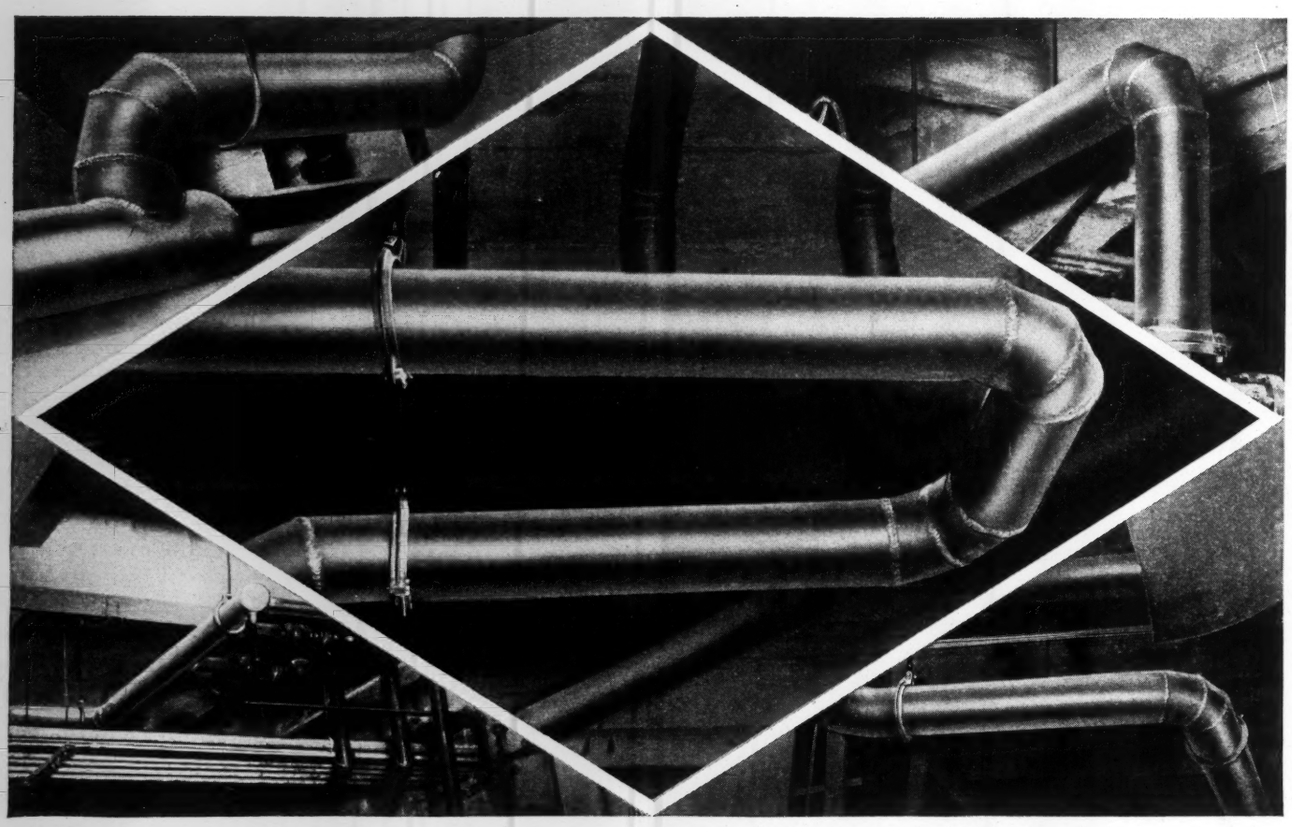
Ask a Byers Engineer or write our Engineering Service Department for complete information on the use of Byers Wrought Iron Pipe in industry. A. M. Byers Company, Established 1864. Pittsburgh, Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Los Angeles.



BYERS GENUINE WROUGHT IRON PRODUCTS

PIPE • WELDING FITTINGS • RIVETS • SPECIAL BENDING PIPE • BAR IRON
PLATES • SHEETS • CULVERTS • FORGING BILLETS • STRUCTURALS

STANDARD of QUALITY for 70 YEARS BYERS 1864 TODAY BETTER THAN EVER



The Thing you cannot Buy is often Worth the Most .. Linde Process Service

ON a six-million dollar building project, Linde engineers cooperated closely on every detail of the piping work. During the preliminary stage, they pointed out to the architect, the contractor and the owners, the construction and maintenance savings possible with welded piping. While the plans were being drawn, they worked closely with the engineers to see that they had the latest data on improved welding practices. During construction, Linde engineers were constantly on the job. On final tests every joint proved completely tight. The owners and architects indicated their complete satisfaction by stating that in future construction they would specify oxwelded joints.

This is Linde Process Service at work.

In this typical case Linde Process Service functioned before work was started—and during construction, they brought the combined resources of a vast organization to bear on the problems involved. The Linde organization has, in its own right, vast facilities for the constant improvement of oxy-acetylene welding and cutting. And, for the study and adjustment of the metallurgical and chemical phases of welding, it has the unique cooperation of other units of Union Carbide and Carbon Corporation which have attained industrial leadership in these fields.

You get in Linde Process Service —when you buy Linde Oxygen—as much cooperation from Linde engineers as you need to assure the greatest benefit from your use of the oxy-acetylene process.

Any Linde man will gladly give you further information about Linde Process Service. Linde Sales Offices are located at Atlanta, Baltimore, Birmingham, Boston, Buffalo, Butte, Chicago, Cleveland, Dallas, Denver, Detroit, El Paso, Houston, Indianapolis, Kansas City, Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Phoenix, Pittsburgh, Portland, Ore., St. Louis, Salt Lake City, San Francisco, Seattle, Spokane and Tulsa. Everything for oxy-acetylene welding and cutting—including Linde Oxygen, Prest-O-Lite Acetylene, Union Carbide and Oxweld Apparatus and Supplies —is available from Linde through producing plants and warehouse stocks in all industrial centers.

● *PIPING, Piping everywhere — reducers, offsets, expansion bends, traps, headers — is welded into strong, economical, everlasting unified systems.*

PRODUCT OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

THE LINDE AIR PRODUCTS COMPANY

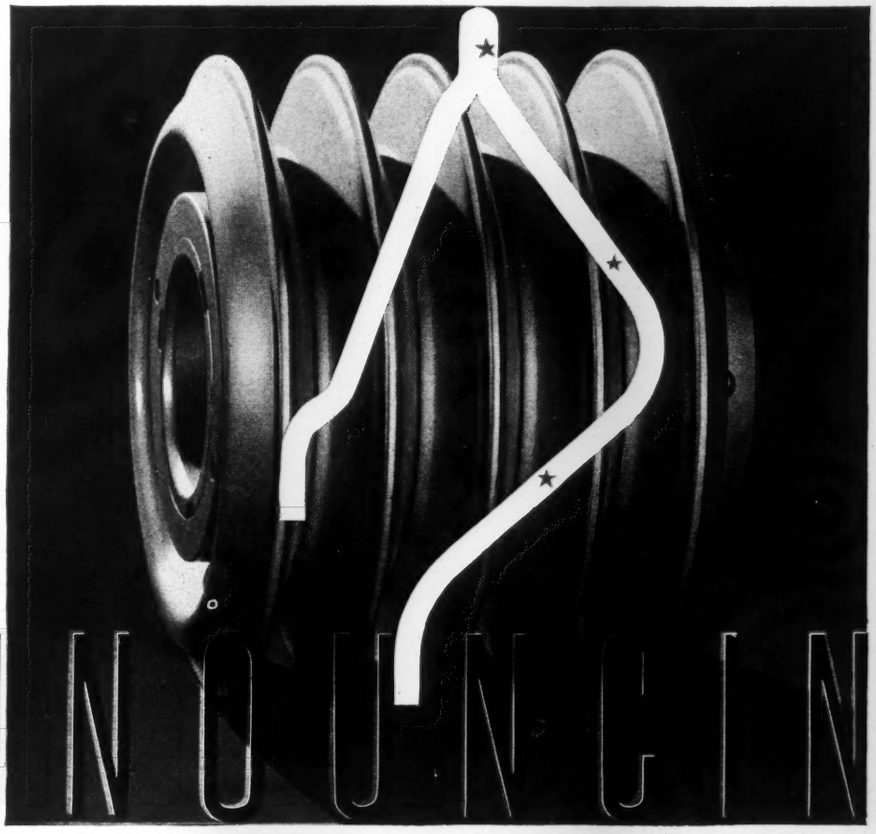
Unit of Union Carbide and Carbon Corporation

UCC NRA CODE

In Canada: Dominion Oxygen Co. of Canada, Ltd.

YOU CAN ORDER EVERYTHING FOR OXWELDING AND CUTTING FROM LINDE

HEATING, PIPING and AIR CONDITIONING, published monthly by Keeney Publishing Co., 6 N. Michigan Ave., Chicago, Ill. Subscription rates: $2.00 per year. Current copies, 25 cents. Back numbers, 50 cents, December, 1934, Vol. 6, No. 12. Entered as Second Class Matter May18, 1929, at the Post Office at Chicago, Illinois, under the act of March 3, 1879.



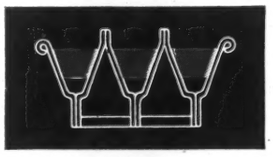
ANNOUNCING!

The new DURO-BRACE TEXSTEEL SHEAVES

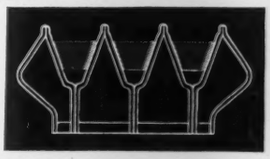
The Allis-Chalmers Manufacturing Company, originators of multiple V belt drives, now offers a new development in sheaves which will withstand the severest duty. • Bending of the outside plate is practically impossible with the new Duro-Brace Sheaves, for in the new design this vulnerable area is braced by a reinforcing convex steel plate, which increases its strength to so great a degree as to eliminate distortion, even under extreme overloads; thus giving a true running drive always. • Duro-Brace Texsteel Drives are 98.9% efficient . . . Require no belt dressing or lubrication . . . Are unaffected by moisture or dust . . . Are Vibrationless, Slipless, Silent, Light and Clean. • Mail us a card asking for Bulletin No. 2188 which sets forth the advantages which Duro-Brace Texsteel Drives offer you in all matters of power transmission, whether they are simple or complex.

★ ★ ★

Former Design: cross-section showing unsupported outside plate.



New Duro-Brace Design: cross-section showing outside plate braced by a convex reinforcing steel plate.

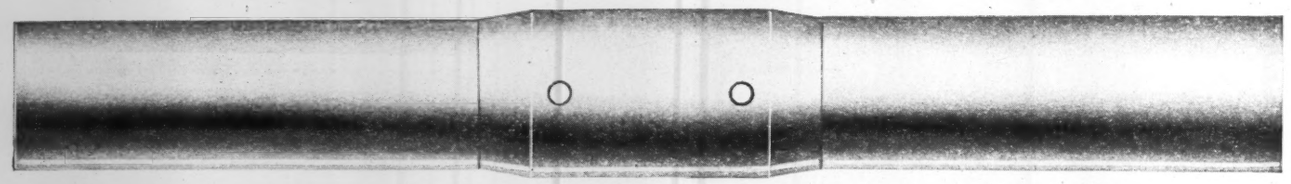


TEXROPE DRIVES

ORIGINATED BY
ALLIS-CHALMERS MANUFACTURING

ALLIS-CHALMERS
COMPANY • MILWAUKEE, WISCONSIN

VIBRATION



WILL NOT LOOSEN IT

RUST

will never have a chance with

TRADE MARK
STREAMLINE
REG. U.S. PAT. OFFICE

FITTINGS AND COPPER PIPE

•

Send for Catalog F

illustrating the complete line of STREAMLINE *Fittings and Copper Pipe — yours for the asking.*

THERE are no threaded or flared joints to loosen by vibration in an installation of STREAMLINE Fittings and Copper Pipe.

Vibration is harmlessly dissipated over the entire system and not localized at threaded joints. The connection formed by a STREAMLINE Fitting is a leak, rust and vibration proof bonded joint of pipe, solder and fitting. (Microphotographs prove this beyond a shadow of a doubt). The joint in an installation of STREAMLINE materials instead of being the weakest point is actually the strongest.

Repeated tests run on a 10 ft. length of ¾ in. vertical pipe containing nine of the patented joints, in which the lower end was held rigid and the upper end attached to a vibrator running continuously, day and night, for one week, showed not the slightest sign of failure at any of the connections. The section of pipe was subjected to 850 vibrations per minute, totalling 8,568,000 vibrations over the week's period. (A severe test this—we believe you'll admit.)

Connections made with STREAMLINE Fittings to hard copper pipe have successfully withstood over 16,000,000 vibrations or tests run for aviation fittings. (Standard Aviation fittings fail, as a general thing, at less than 8,000,000 vibrations).

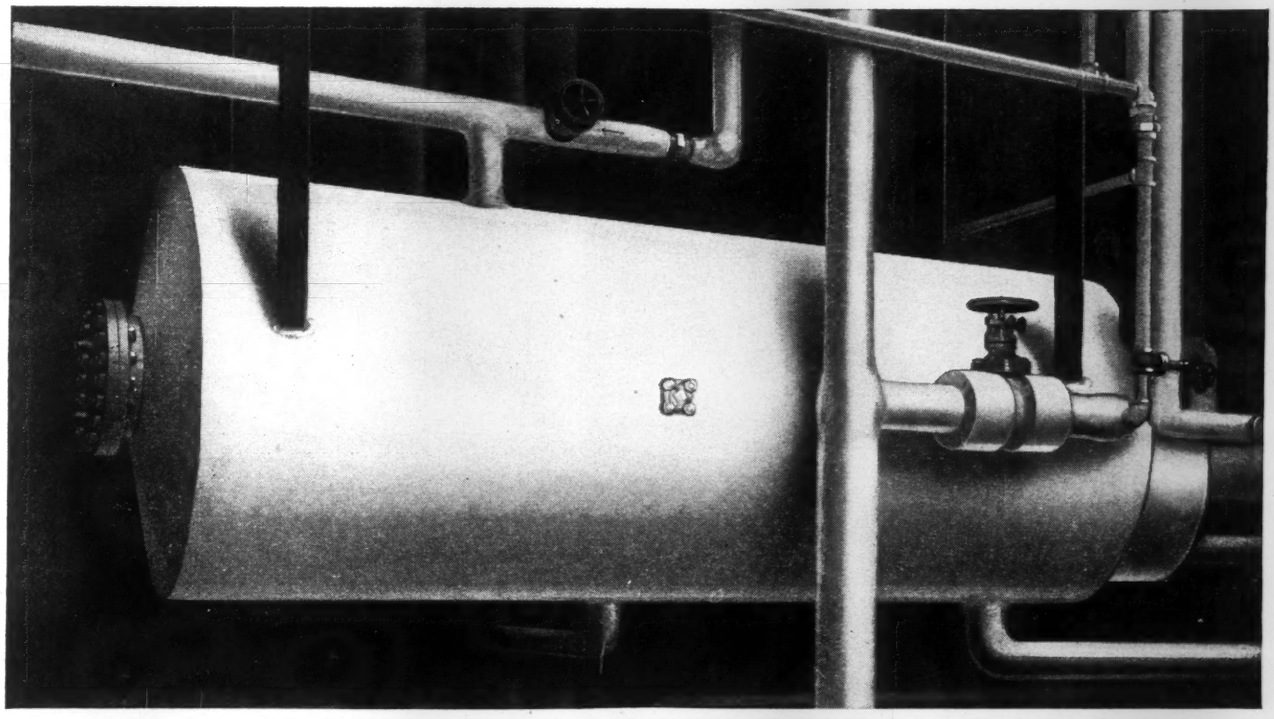
Absence of clogging and freedom from the harmful effects of rust and vibration are but a few of the many reasons why STREAMLINE protects the building owner from costly repair bills and gives him a trouble free conducting system as long as the building stands. It will pay you to investigate the possibilities of a modern STREAMLINE installation either for replacement or new work.

STREAMLINE PIPE AND FITTINGS

PORT HURON, CO. MICHIGAN

DIVISION OF MUELLER BRASS CO.

Storage heater of *Durable, rustless* EVERDUR services another MONUMENTAL BUILDING



Everdur storage heater, designed for 150 lbs. working pressure, made by PATTERSON-KELLEY CO., INC., for Bronx County Court House. *Architects:* Joseph H. Freedlander & Max Hausle. *Consulting Engineers:* Pattison Bros. *General Contractors:* William C. Kennedy Construction Co.

IN THE Bronx County Court House, New York City, a storage heater of rustless Everdur is delivering *clean* hot water, and will continue to do so with a minimum of maintenance expense. This installation, the first large Everdur heater in Metropolitan New York, dates back to 1932, when this monumental building was erected. Since then, Everdur heaters have become widely favored for apartment houses and office buildings, textile mills and laundries, hospitals and other institutions.

Welded Everdur heaters solve the problem of rust and rust expense—always perplexing to building managers and burdensome to owners. Everdur* is made in all commercial shapes, including tank plates which meet the physical requirements of the A. S. T. M. Boiler Code, Flange Plate Specifications, and S. A. E. Specifications 1010 and 1015. For additional data and names of fabricators, address our nearest office.

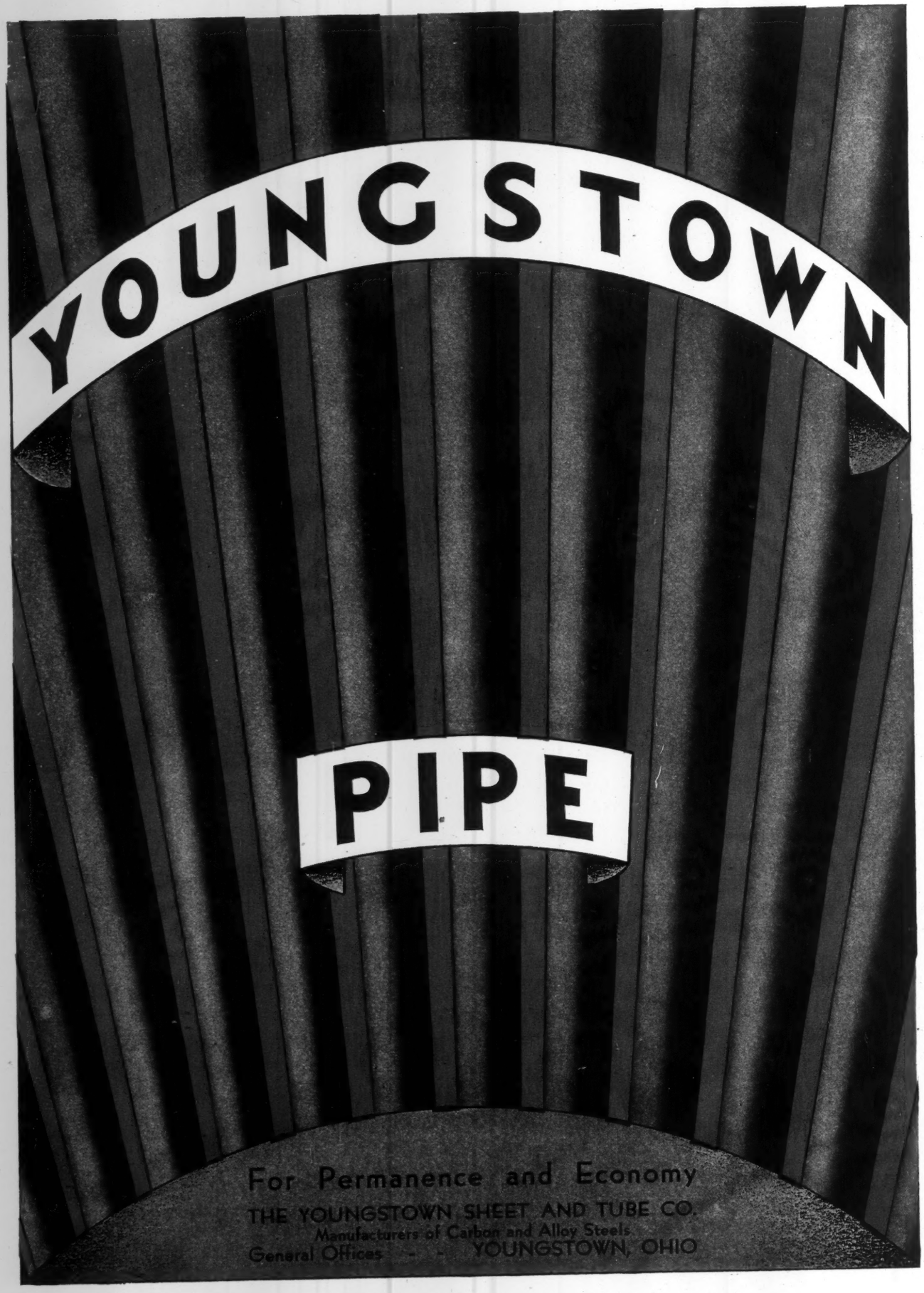
*"Everdur" is a registered trademark identifying products of The American Brass Co. made from alloys of copper, silicon and other elements.

ANACONDA from mine to consumer

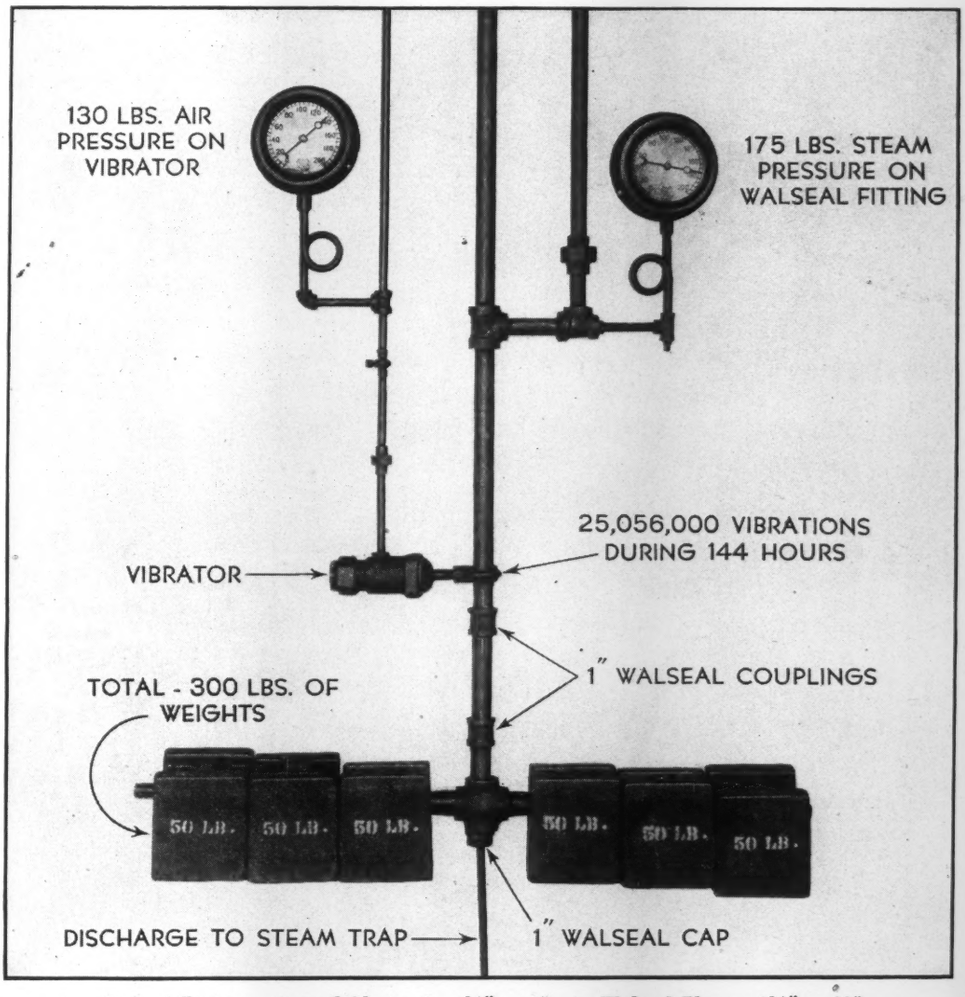
THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities

NRA CODE

EVERDUR METAL *for* TANKS


YOUNGSTOWN
PIPE
For Permanence and Economy
THE YOUNGSTOWN SHEET AND TUBE CO.
Manufacturers of Carbon and Alloy Steels
General Offices - - YOUNGSTOWN, OHIO

"WE KNOW OF NO BRONZE FITTING OTHER THAN *WALSEAL THAT CAN WITHSTAND THESE CONDITIONS"



Walseal Fittings are available in sizes ¼" to 8" — Walseal Flanges 1½" to 12"

The operating conditions given above namely—

175 lbs. Steam Pressure...25,056,000 vibrations in 144 hours with 300 lbs. of weights directly suspended on a Walseal cap.

—is an unusual combination but not too severe for Walseal. After completing this test the assembly was tested to 600 lbs. hydraulic pressure and was found perfectly tight. The Fittings used were standard weight Walseal Fittings taken from stock. * *Reg. U. S. Pat. Off.*

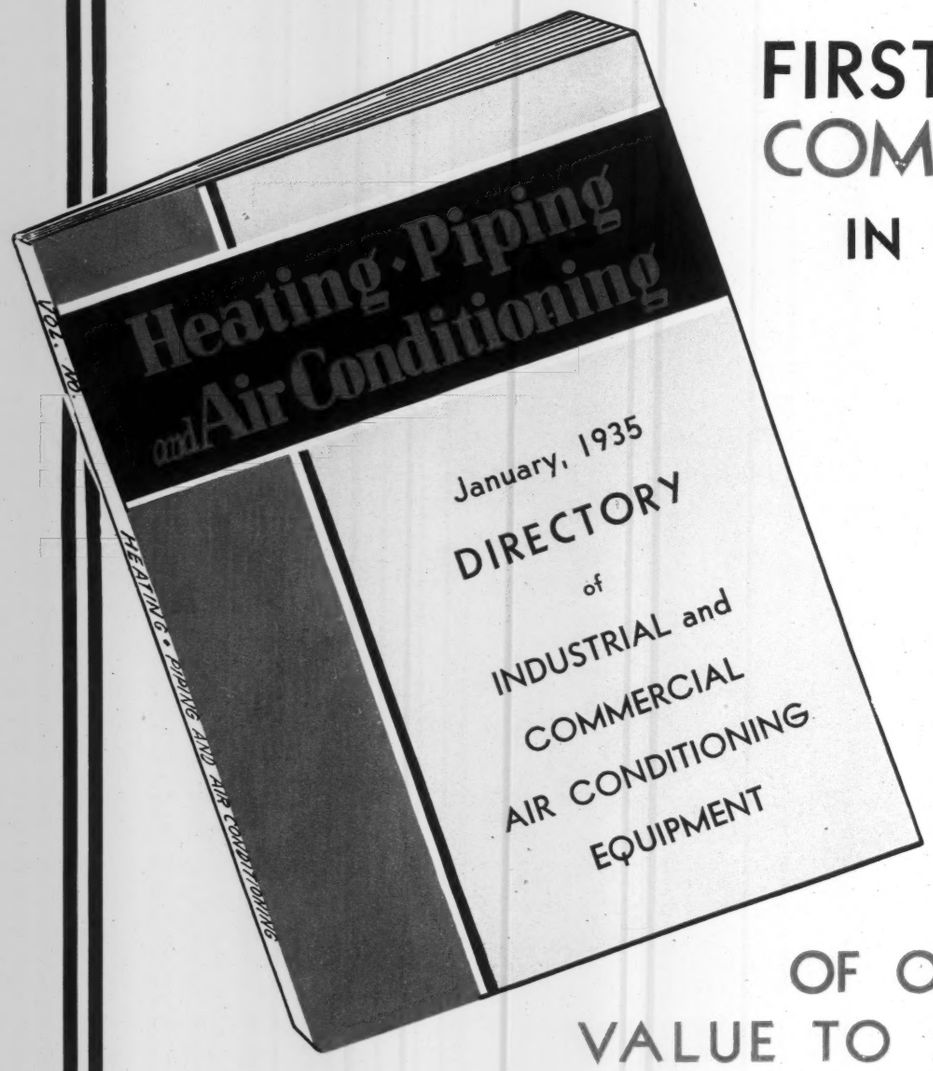
WALWORTH

VALVES FITTINGS and TOOLS
Backed by 91 Years Service

WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

DISTRIBUTORS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

Watch for • • •



FIRST COMPLETE D
COMMERCIAL AIR C
IN THE JANUARY 1
HEATING • • • P

Over 7,000 distribution to the key factors involved in the design, specification, purchase, installation and operation of all types of industrial and commercial air conditioning equipment.

OF OUTSTANDING VALUE TO ADVERTISERS

- In such a Directory the manufacturer has a real opportunity to capitalize on a definite buying interest. It is an excellent tie up—a listing in the Directory Section to inform the buyer that you make the product in which he is interested, a complete showing of your products in the advertising section to give the buyer the information he needs to make the purchase.

- As an advertiser your name will be prominently "spotted" wherever it appears throughout the Directory section, with reference to the fact that your advertisement appears in this issue. Plan to make a full showing of your complete line.

HEATING, PIPING and AIR CONDITIONING

DIRECTORY OF INDUSTRIAL AND CONDITIONING EQUIPMENT!

1935 ISSUE OF PIPING & AIR CONDITIONING

OF OUTSTANDING VALUE TO BUYERS AND SPECIFIERS . . .

- **Sec. 1—PRODUCTS CLASSIFIED**
  In this section every product and accessory used in industrial and commercial air conditioning work will be listed. Under each one will be the names of all manufacturers who make it. An engineer, a contractor or manufacturer who wants to know where he can buy or secure information on a certain product can turn to this section, find the product properly indexed and cross-indexed, see under it the names of all manufacturers who make it.

- **Sec. 2—TRADE NAMES**
  Here the buyer who knows of a product only by its trade name can find its maker by looking for that trade name in its proper alphabetical place. Every trade name of a product in this field is listed in this section, with the product it designates and the name of its manufacturer.

- **Sec. 3—MANUFACTURERS' ADDRESSES**
  In this section all manufacturers will be listed with complete street address and city. Here the buyer finds out where to direct his inquiry or his order.

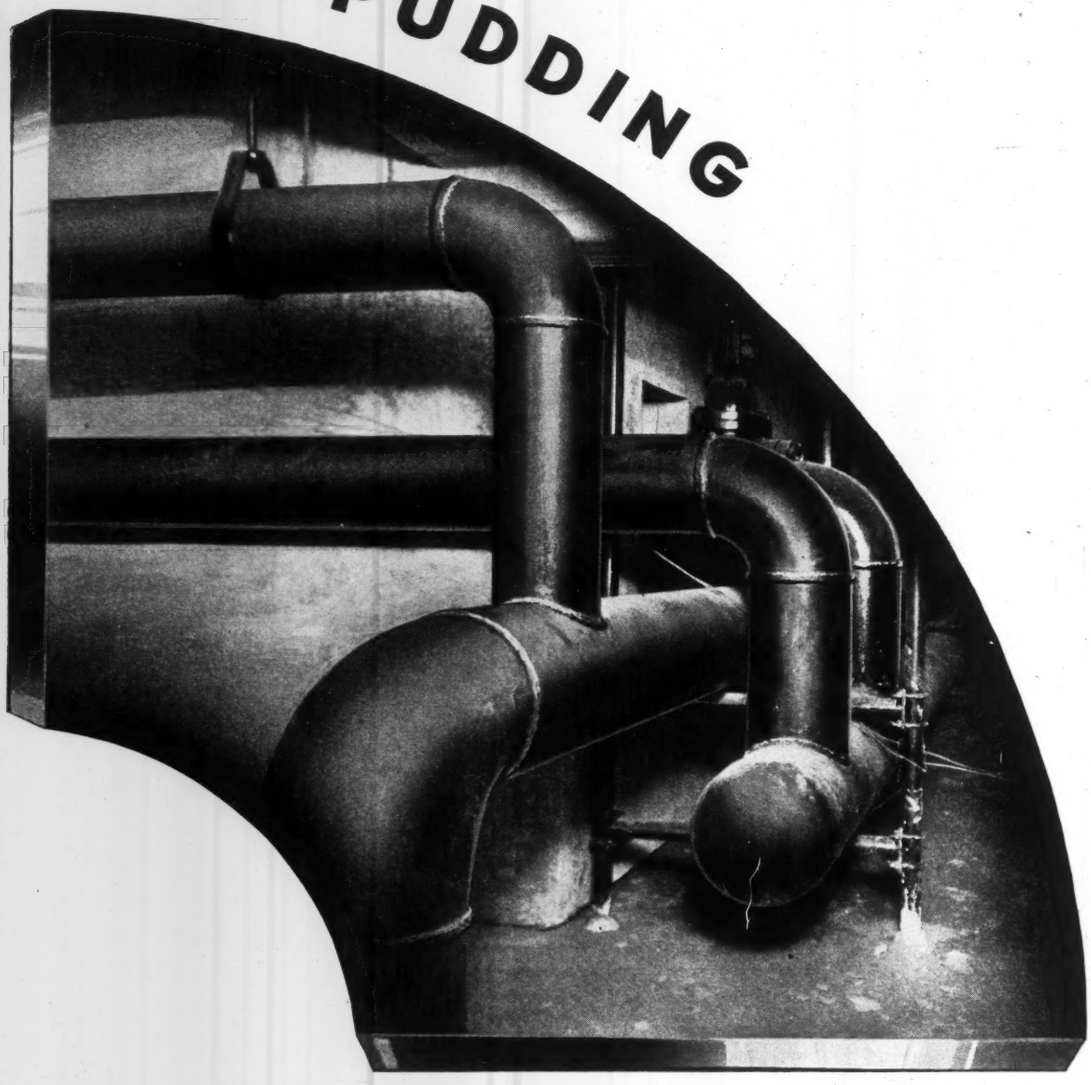
- **OUTSTANDING EDITORIAL SECTION**
  The regular editorial section of this issue will not be sacrificed to the Directory. Rather, it will be keyed to the year-round nature of the number by presenting articles of basic, worth-keeping engineering and practical data.

  Air conditioning developments and progress will be recorded by authorities. Outstanding heating and piping articles will be included, as will the Journal Section of the American Society of Heating and Ventilating Engineers.

  The Directory Section, in other words, will be a complete addition to the regular January issue.

CHICAGO Make Your Reservation NOW!

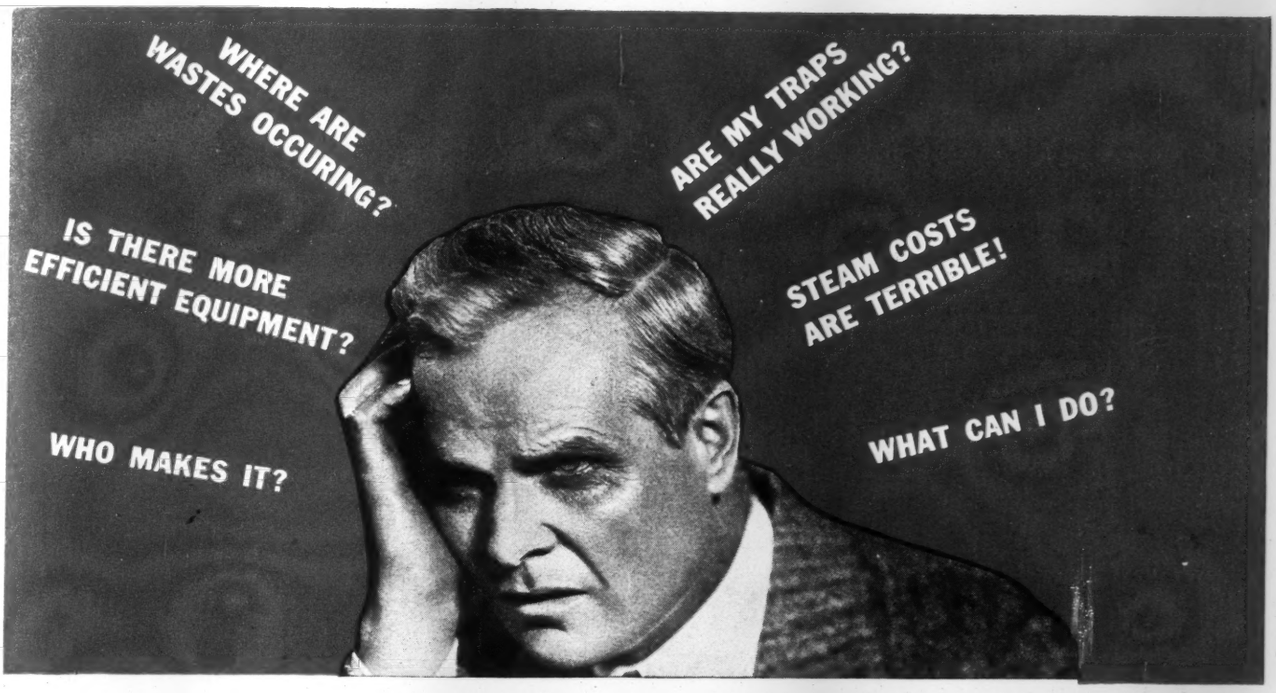
THE PROOF OF THE PUDDING



TUBE-TURNS

You've heard everything there is to hear about the exclusive features of Tube-Turns★—their uniform walls, true circular cross-section, smooth radius of curvature. • • But this is not the proof of the pudding. The final proof of Tube-Turn superiority lies in the fact that for seven successive years, American industry has vastly preferred Tube-Turns for every kind of pipe-welding job. . . . Tube-Turns, Incorporated, 405 Herald-Post Building, Louisville, Kentucky.

★ The word "Tube-Turn" is NOT a general name for welding fittings. Tube-Turns are THE seamless fittings having uniform wall-thickness at all points, true circular cross-section, uniform radius of curvature and smooth inner walls. Made ONLY by Tube-Turns, Incorporated.


WHERE ARE WASTES OCCURING?
ARE MY TRAPS REALLY WORKING?
IS THERE MORE EFFICIENT EQUIPMENT?
STEAM COSTS ARE TERRIBLE!
WHO MAKES IT?
WHAT CAN I DO?

LET HOFFMAN HELP YOU FIND THE ANSWERS . . .

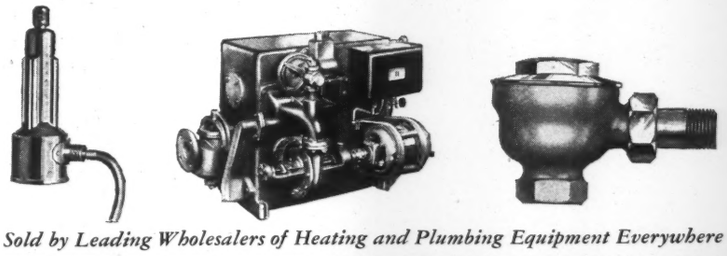
Hundreds of power engineers are asking for the facts on Hoffman's latest fuel-saving methods and equipment

Perhaps your steam plant is obsolete—equipment put in years ago no longer meets modern efficiency demands. Perhaps it is inadequate. Perhaps a pump is needed. But whatever the reasons for those high steam costs, they can easily be eliminated. How to do it is a problem on which Hoffman will gladly assist you.

Many engineers, faced with the necessity of cutting costs, have found valuable help in Hoffman's advisory service. For daily it becomes increasingly apparent that modernization is the only remedy for extravagant heating costs.

In Hoffman's complete line of fine heating specialties is all the equipment needed to put old-fashioned, wasteful heating plants on a money-saving basis. Hoffman Traps, Valves and Pumps are made in a wide utility and price range and are distinguished by numerous patented features you will find in no other similar products.

If you didn't take advantage of the offer made in the Hoffman literature recently sent you, it's not too late. Send the coupon today. There is absolutely no obligation.



Sold by Leading Wholesalers of Heating and Plumbing Equipment Everywhere

HOFFMAN

SPECIALTY CO., Inc.

Makers of Supply Valves, Venting Valves, Traps and Hoffman-Economy Pumps

HOFFMAN SPECIALTY CO., Inc.
Dept. FG-60, Waterbury, Conn.

Send me descriptive bulletins on ☐ Hoffman Venting Valves, ☐ Hoffman Traps, ☐ Hoffman-Economy Pumps. ☐ Have your representative call.

Name.....

Address.....

City.....

ARCHITECTS
Corbett,
Harrison & MacMurray
Hood & Fouilhoux
Reinhard & Hofmeister

CONSULTING ENGINEER
Clyde R. Place

VENTILATING & AIR CONDITIONING CONTRACTORS
Almirall & Co.
Baker, Smith & Company
Carrier Engineering Corporation
Gillis & Geoghegan, Inc.
Wolff & Munier

© FAIRCHILD AERIAL SURVEYS, INC., N. Y. C.

American Air Filter Installations In ROCKEFELLER CENTER

Bldgs. No. 1 and No. 9
American Multi-Panel . . . 199,350 C.F.M.

Bldg. No. 2 (French Bldg.)
American Multi-Panel . . . . 42,500 C.F.M.
American Renu-Vent . . . . . 60,000 C.F.M.

Bldg. No. 3 (British Bldg.)
American Multi-Panel . . . . 26,000 C.F.M.

Bldg. No. 8
American Airmat . . . . . 150,000 C.F.M.

Bldg. No. 10
American Airmat . . . . . 303,000 C.F.M.
American Multi-Panel . . . . . 5,300 C.F.M.

Bldgs. No. 4A, 4B and 6
American Multi-Panel . . . 178,300 C.F.M.
American Renu-Vent . . . . . 96,300 C.F.M.

TOTAL CAPACITY AMERICAN AIR FILTERS
. . . . . 1,060,750 C.F.M.

AMERICAN AIR FILTERS *again* SELECTED FOR ROCKEFELLER CENTER

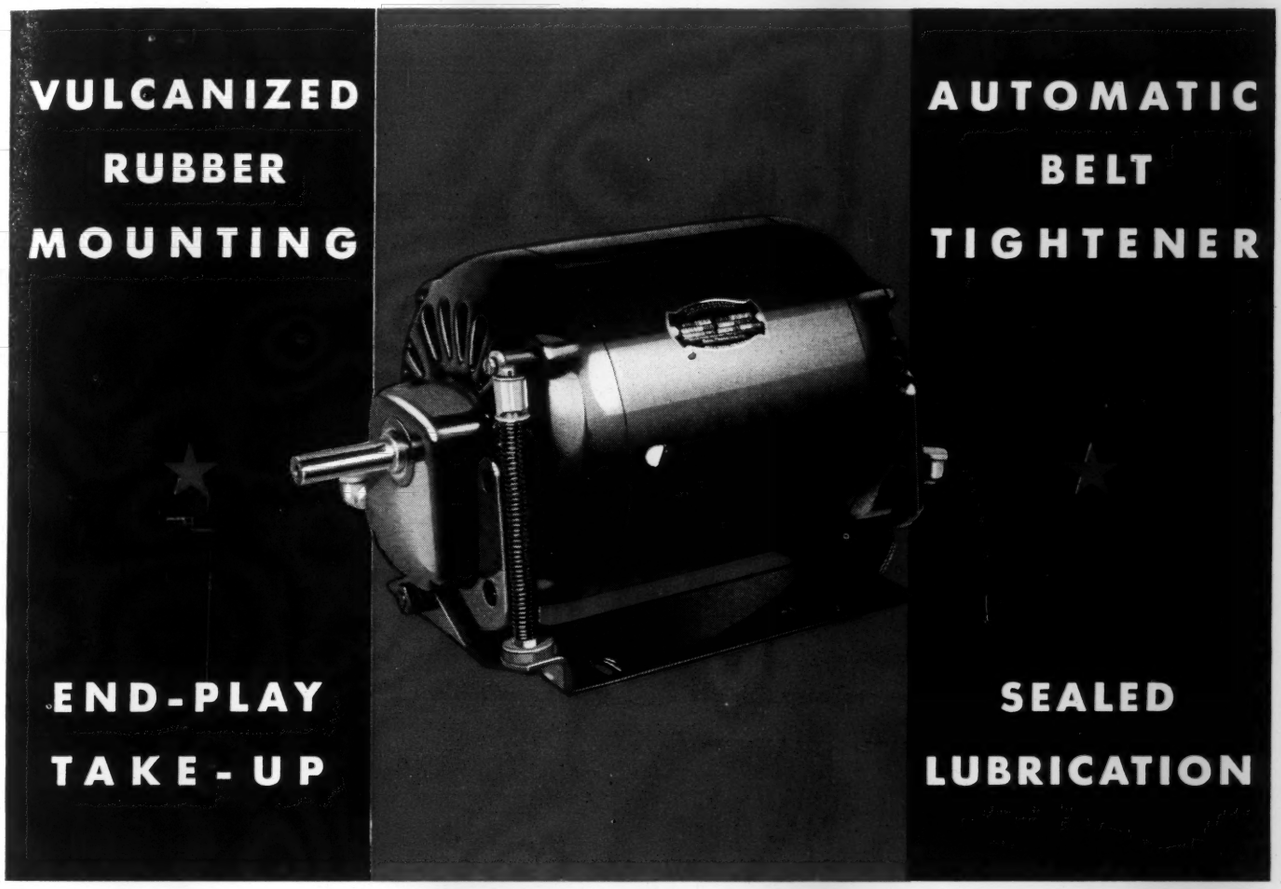
● The most recent additions to Rockefeller Center, buildings 4A, 4B and 6 of the International Group now under construction are to have American Air Filters as an integral part of their ventilating and air conditioning systems.

This is the ninth installation of American Air Filters in Rockefeller Center, bringing the total capacity up to 1,060,750 C.F.M. These installations include MULTI-PANEL, AIRMAT and RENU-VENT filters—each type selected for the particular service to which it is best suited. American Air Filters, because of their dependability, efficiency and over-all economy are the choice of experienced engineers wherever a product proved by years of service is required.

AMERICAN AIR FILTER COMPANY, *Inc.*
107 Central Avenue Louisville, Kentucky
In Canada, DARLING BROTHERS, LIMITED, Montreal, P. Q.

NRA MEMBER U.S. WE DO OUR PART

AMERICAN AIR FILTERS



FEATURES THAT YOU NEED IN AN AIR CONDITIONING MOTOR

To insure the QUIET OPERATION AND DEPENDABILITY that are so essential in air conditioning units, Delco motors have *Vulcanized Rubber Cradle Mounting*—which absorbs all vibrational noises by means of live rubber vulcanized to two plates, one attached to the motor and one to the mounting bracket; *Automatic Belt Tightener*—which compensates for belt stretch and prevents motor oscillation by assuring proper tension on the belt at all times; *Sealed Lubrication*—which provides proper, continuous, automatic lubrication; also *End-Play Take-Up*—which eliminates end-play noise by means of cork cushions on each end of the rotor shaft. Those who are now designing air conditioning equipment should consider these Delco features. Delco offers a complete line of air conditioning motors up to 20 h.p., including high-quality, quiet motors for the circulating fans in air conditioners.

DELCO PRODUCTS CORPORATION, DAYTON, OHIO

DELCO MOTORS

Tribute to a Great American

On December 22, 1800, Paul Revere wrote to a friend: "I have engaged to Build me a Mill for rolling Copper into Sheets, which for me is a very Great Undertaking, and will require every Farthing which I can Rake or Scrape."

The mill was built . . . and Revere's copper was soon the standard of the Colonies. His copper was used to roof many important buildings; his bells sounded from sixty churches throughout New England; and his spikes, bolts, and copper sheathing were used for the new fleet of frigates . . . headed by the famous "Old Ironsides."

Looking back over these Colonial days, Revere Copper and Brass Incorporated recognizes that it owes more to the illustrious "midnight rider" than the fact that he founded the present company. For Revere was great, not only as a patriot, but as the foremost industrial pioneer. He tirelessly sought to do things in new and better ways. And as an artist and craftsman, he insisted on fine materials and painstaking workmanship.

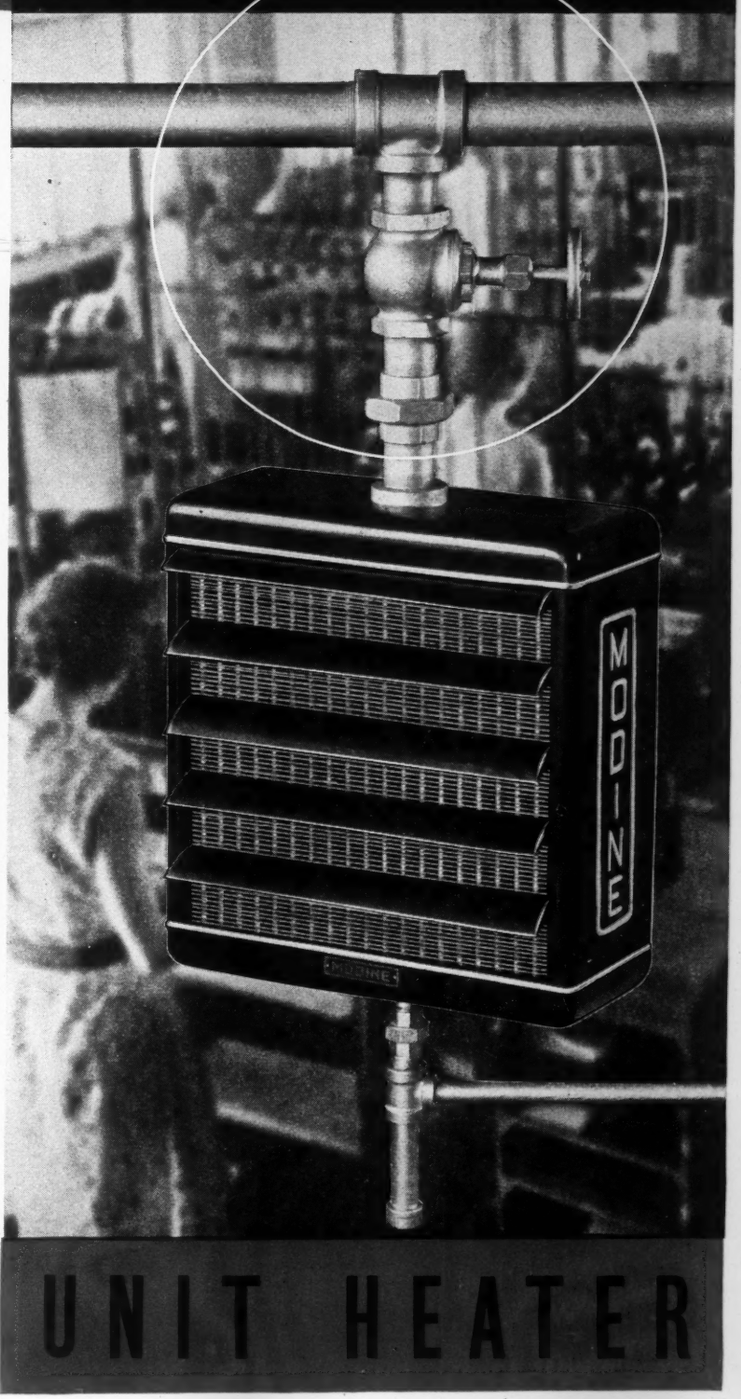
It is this spirit, maintained through one hundred and thirty-four years of growth and consolidation, that is this company's proudest possession.

Paul Revere

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere

Only MODINE HAS DIRECT PIPE SUSPENSION



...INSTALLATION IS EASIER AND COSTS LESS

It costs the heating contractor far less to install the new Modine than any other unit heater. Suspended directly from the steam line, Modine needs no brackets, pipe rods or straps—the supply connection is the only support required. Material costs are less—and the installation is made in quicker time and with less labor.

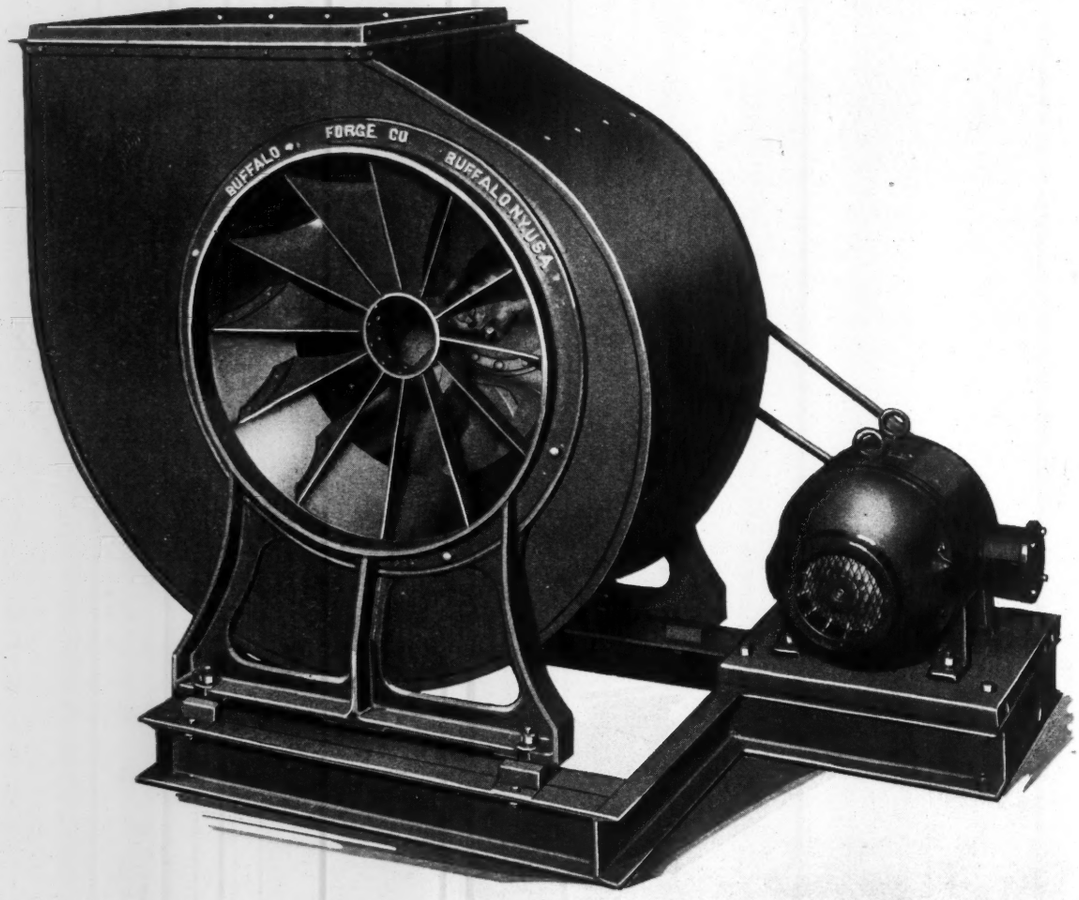
This *direct suspension*, which also simplifies relocation, is combined with 360° *rotatability*, which makes it easy to change the direction of the air stream. All new Modine models, except the twin units, 1545 and 2015, have these features.

Modine all-around better heating is a result of these and other exclusive mechanical superiorities covered by U. S. and foreign patents. That's why *more Modines are sold than any other unit heater.*

MODINE
MANUFACTURING COMPANY
1750 RACINE STREET
RACINE, WISCONSIN

WRITE FOR FREE BOOK

The NEW MODINE UNIT HEATER



Quiet AND Efficient

. . . And we mean REALLY quiet—the kind of fan that you can install for churches, libraries, theaters, conference rooms and like locations.

. . . It's efficient to the extent that you will probably save money on horsepower.

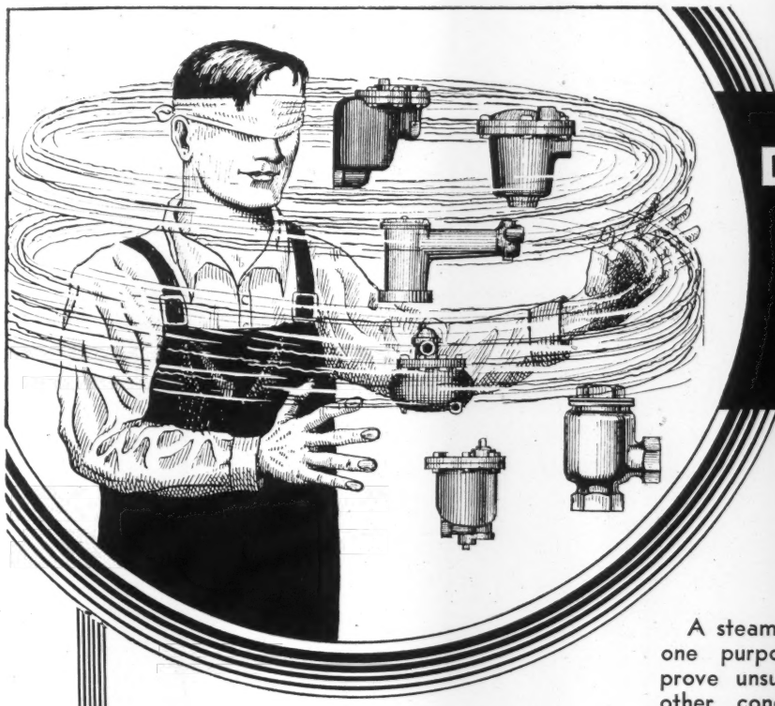
. . . It's sturdy enough to more than satisfy the industrial user.

Unusual NEW BULLETIN

We have just issued a sixteen page bulletin filled with illustrations and information covering the Buffalo Limit-Load Fan and its remarkable silent, floating base. You will want a copy. Ask for Bulletin 2955.

Buffalo Forge Company
171 Mortimer St. Buffalo, N. Y.
In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" Limit-Load (REG. U.S. PAT. OFF.) Conoidal Fan *with* Silent Floating Base



Don't Try To Pick Steam Traps Blind-Folded!

A steam trap right for one purpose will often prove unsuitable for another condition. Large sums are wasted by trying to use the same kind of steam trap for every industrial application.

Sarco has long recognized that there is no "universal" steam trap, therefore provides several different types from which to select the one best suited.

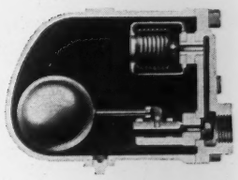
Sarco No. 9-2 Thermostatic Steam Trap leads the line. This is the type which changed engineering practice from old-fashioned group trapping, by means of a few large, centrally located traps, to individual trapping (a trap on every coil).

This is the system we recommend for most steam-heated process equipment, operating at pressures from 0 to 125 lbs.

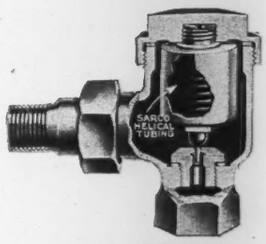
For applications where condensate must be removed as fast as it forms, regardless of the heat units thus wasted, Sarco Float-thermostatic Steam Traps are best adapted. These are preferred, for example, on large unit heaters, hot water generators, ironers in laundries, and calenders (or dry cans) in textile mills.

On extensive systems, where condensate cannot be returned to the boiler, there is no better or more economical steam trap than Sarco No. 8. Even on high pressure (up to 300 lbs.) it discharges only cool condensate with a minimum of "flash" steam.

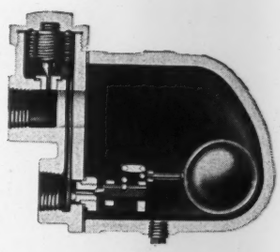
Put your steam trap problems up to us. Write today for Catalog O-48 and full information. There is no obligation, and our experience in this special field may save you money and help you.



FTL

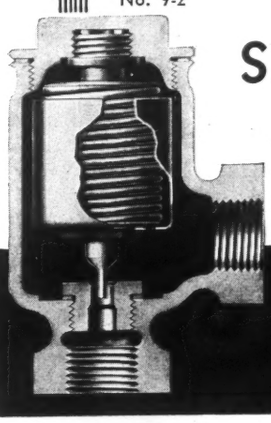


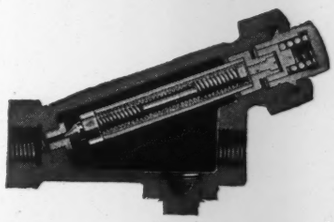
No. S-75



FTH

No. 9-2





No. 8

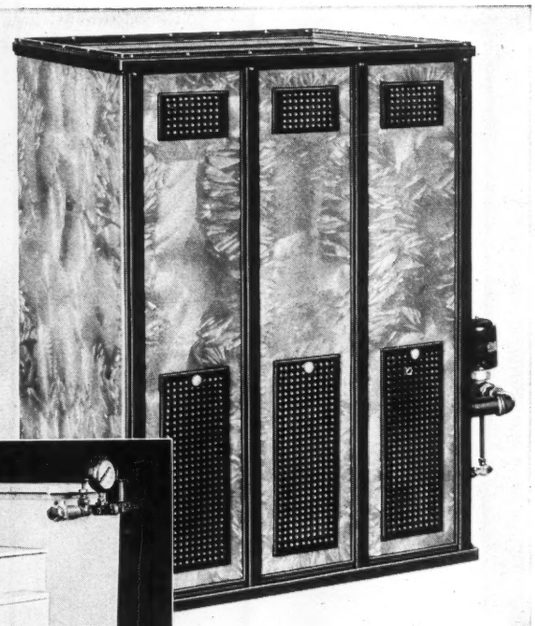
SARCO COMPANY, *Inc.*

183 Madison Ave.
NEW YORK, N. Y.

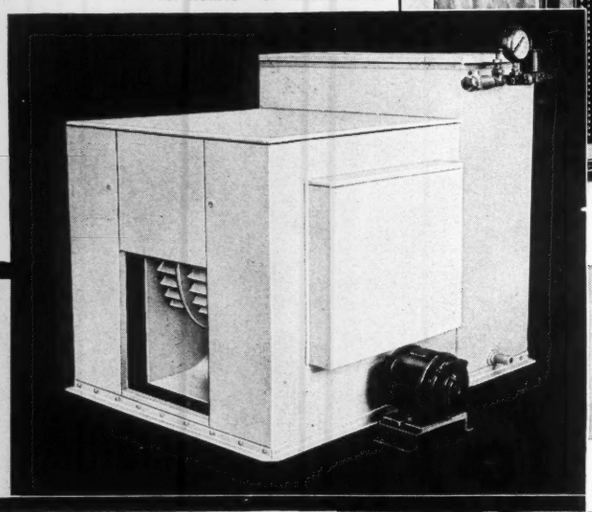
Branches in Principal Cities
Sarco Canada Limited, Federal Bldg., Toronto, Can.

SARCO STEAM TRAPS

How Inland Sheets Have Helped in Air Conditioning



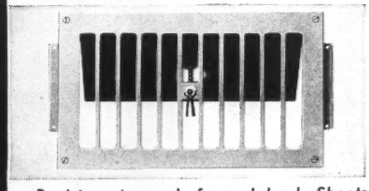
Below: Air conditioning unit for homes—of Inland Steel



NRA CODE

INLAND OPEN HEARTH STEEL

Gas-burning furnace given attractive appearance and quality with Inland Steel



Register stamped from Inland Sheets

THE "made-weather" industry offers an example of how Inland keeps pace with the most modern needs for steel.

Back when man attempted to do nothing about the temperature of the air except to endeavor to keep warm, furnace and stove manufacturers found Inland a satisfactory source for steel. And now manufacturers and installers of the equipment which promises to make weather man-controlled in home and office find valuable help at Inland.

They secure the results of most modern equipment, of minute care, of experience not only in the making of steel to difficult requirements but in its application. INLAND STEEL COMPANY, 38 S. Dearborn Street, Chicago, Ill.

1500 tons of Inland Galvanized Steel Sheets were used for ducts in the new Chicago Post Office.

INLAND STEEL

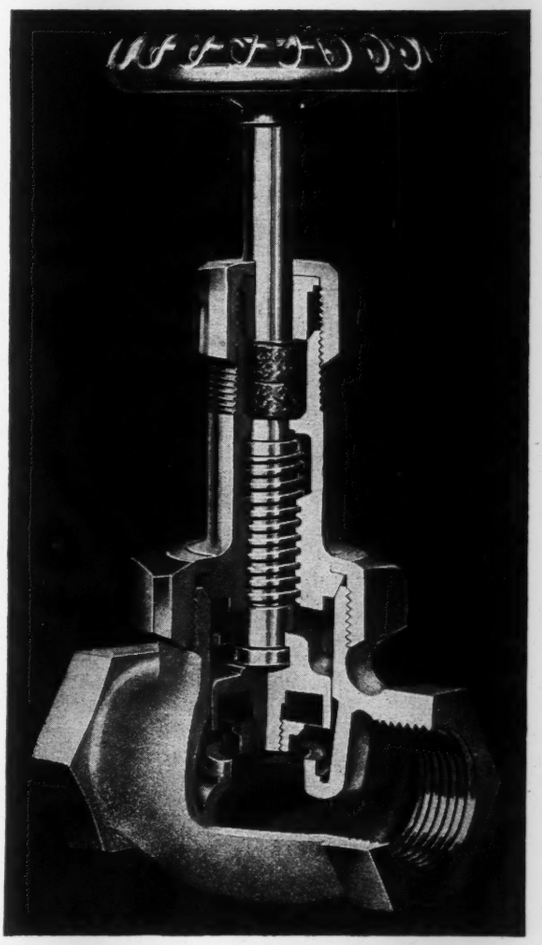
ABLE SERVANT OF THE CENTRAL WEST

Sheets Strip Tin Plate
Plates Structurals Piling

Rails Track Accessories
Bars Rivets Billets

Announcing FAIRBANKS

Improved Globe and Angle VALVES



These *improved* Fairbanks Valves are designed to reduce maintenance trouble and expense. They possess many important features such as:

1. The radial seat, between body and bonnet, not only insures a tight joint at this important point but also perfect alignment of all parts. The proper alignment of parts decreases wear; and, when the valve is taken apart for disc replacement, the alignment will be perfect. This seat is drawn to a tight joint by the union nut without sliding or scraping the surface of seat, thereby increasing the life of the valve and assuring a tight body-joint after every assembly.

2. The disc ring not only serves efficiently in the control of steam but also on hot and cold water. It is composed of a very high percentage of long-fibered asbestos, compounded with the necessary vulcanizing elements and given a special cure that produces a most efficient and reliable disc ring.

3. The disc holder is of standard dimensions, permitting the use of other standard makes of disc rings if desired.

4. The stem is of rolled rod bronze, averaging 65,000 pounds tensile strength. More than five clean-cut Acme threads are at all times in contact with the bonnet.

5. The union nut is of heavy bronze with large hexes for a firm wrench grip and permits removal of bonnet with less risk of damage.

6. The protected top seat above the threads on stem gives greater assurance of a clean, tight joint when the valve is fully opened for the purpose of repacking the valve under pressure.

7. The ventilated, malleable-iron handwheel assures a firm, cool grip. The bronze nut holding the wheel is well below the wheel rim surface, thus protecting the hand. This nut is securely held with a lock washer.

Examination of this valve will disclose many other evidences of careful engineering such as the interchangeability of all parts of globe and angle valves, extra large seating surfaces and non-binding disc regardless of position of valves.

Write for copy of our new catalog, or mail the coupon.

THE FAIRBANKS CO.

Manufacturers of Valves, Trucks and Wheelbarrows

396 Lafayette St., New York, N. Y.

Boston, Pittsburgh—Distributors in Principal Cities

MAIL COUPON TODAY!

The Fairbanks Co.,
396 Lafayette St., New York, N. Y.

Without obligation on our part, kindly send a copy of your catalog.

Name .....

Address .....

City ..... State .....

Perfect Harmony

MODINE BEAUTY... EMERSON PRECISION-BUILT MOTORS

PRECISION

Not *one* Emerson motor part is permitted to pass until skilled workers have gauged it true to the rigid requirements established by Emerson Engineers. Not *one* Emerson Motor leaves for duty until it has been "on the testing line" to prove its fitness. Strict adherence to the 45 year old policy of "precision" manufacturing has definitely established Emerson as leaders in the fan and motor industry — yet, Emerson Motors are competitively priced.

When the Modine Company, Racine, Wisc., decided to redesign their Unit Heaters and build in beauty from front to back, they were pleasantly surprised to find that Emerson motor performance was equally matched by the beauty of Emerson design and finish.

Perhaps years of continuous, trouble-free service are all you ask of a motor. For this job, Emerson has 45 years of building precision-motors up to 3 H.P. to its credit. But if appearance is also a factor—then the Emerson Motor will harmonize just as perfectly as it has with Modine.

Emerson experience, modern, scientific laboratory equipment and individual engineering service will build for you the motor to meet your requirements. Write today for the bulletin 13P—"Tests—Hundreds of Tests", also additional specific examples of the application of Emerson Motors in your field.

EMERSON MOTORS

3 HP and smaller—Single-phase—Polyphase—Direct Current

THE EMERSON ELECTRIC MFG. CO.
NEW YORK ST. LOUIS CHICAGO

LEADERS IN THE FAN AND MOTOR INDUSTRY SINCE 1890

NUMBER of air conditioning installations for 1934 as reported for various cities continues to indicate that 1935 should be an "air conditioning year." . . . For Cincinnati, there were 43 installations prior to 1933, 32 made during 1933, and over 70 during the first nine months of 1934. . . . Fifty-six installations have been made in Pittsburgh during 1934, it is reported, with a total of 326 tons of refrigeration and 415 horsepower.

THE Santa Fe railroad expects to spent $1,800,000 for air conditioning its trains, tripling the number of its air conditioned cars, by the opening of the 1935 season. . . The Pullman Company is to double the number of its air conditioned cars for the summer of 1935. . . The Chesapeake & Ohio's poster "Sleep Like a Kitten," featuring genuine air conditioning of its cars, won third award at the annual exhibition of outdoor art in Chicago last month. . . 2,500 passenger cars are to be air conditioned by western railroads for the 1935 cooling season.

A SECOND open forum on air conditioning for comfort has been arranged to start January 14 at the David Ranken Jr. school of mechanical trades in St. Louis, according to George B. Rodenheiser, head of the heating and ventilating department. . . The tentative outline includes discussions of determination of the heating and cooling loads; air circulation, cleaning and humidification; practical application of air conditioning to small commercial establishments, and other subjects. . . Next year promises more than ever to be an air conditioning year, says Elliott Harrington of G. E., with even more rapid expansion of air conditioning in commercial establishments such as theaters, restaurants, and shops. Offices, apartments, hotels, railway cars, and homes will contribute to this growing market.

THE Yates-American Machine Co., Beloit, Wis., is to manufacture heat transfer surface, unit heaters, fin coils for air conditioning, it has been announced. . . . Consolidation of the interests of the Carbondale Machine Co., Carbondale, Pa., with those of the Worthington Pump and Machinery Corp. in the general refrigeration field, operating in the future as the Carbondale Machine Corp., was announced last month. . . Manufacturing facilities of three companies making refrigerators, commercial condensing units, and air conditioning equipment (Copeland Refrigeration Corp., Trupar Mfg. Co., and Zerozone Refrigeration Corp., of Mount Clemens, Mich., Dayton, Ohio, and Chicago, respectively) have been consolidated in Detroit, Mich. . . Dallas E Winslow, Inc., is the parent corporation. . . Hexcel Radiator Co. is moving from Milwaukee to a modern, daylight factory in Racine, Wis. . . John G. Zummach has become chief engineer in charge of the company's commercial and air conditioning branch. . . J. L. Blackshaw, formerly of the A. S. H. V. E. research staff has been appointed to the building products division of the Reynolds Metals Company, will have complete charge of all heating, ventilating and related technical problems in connection with the company's metal foil insulation

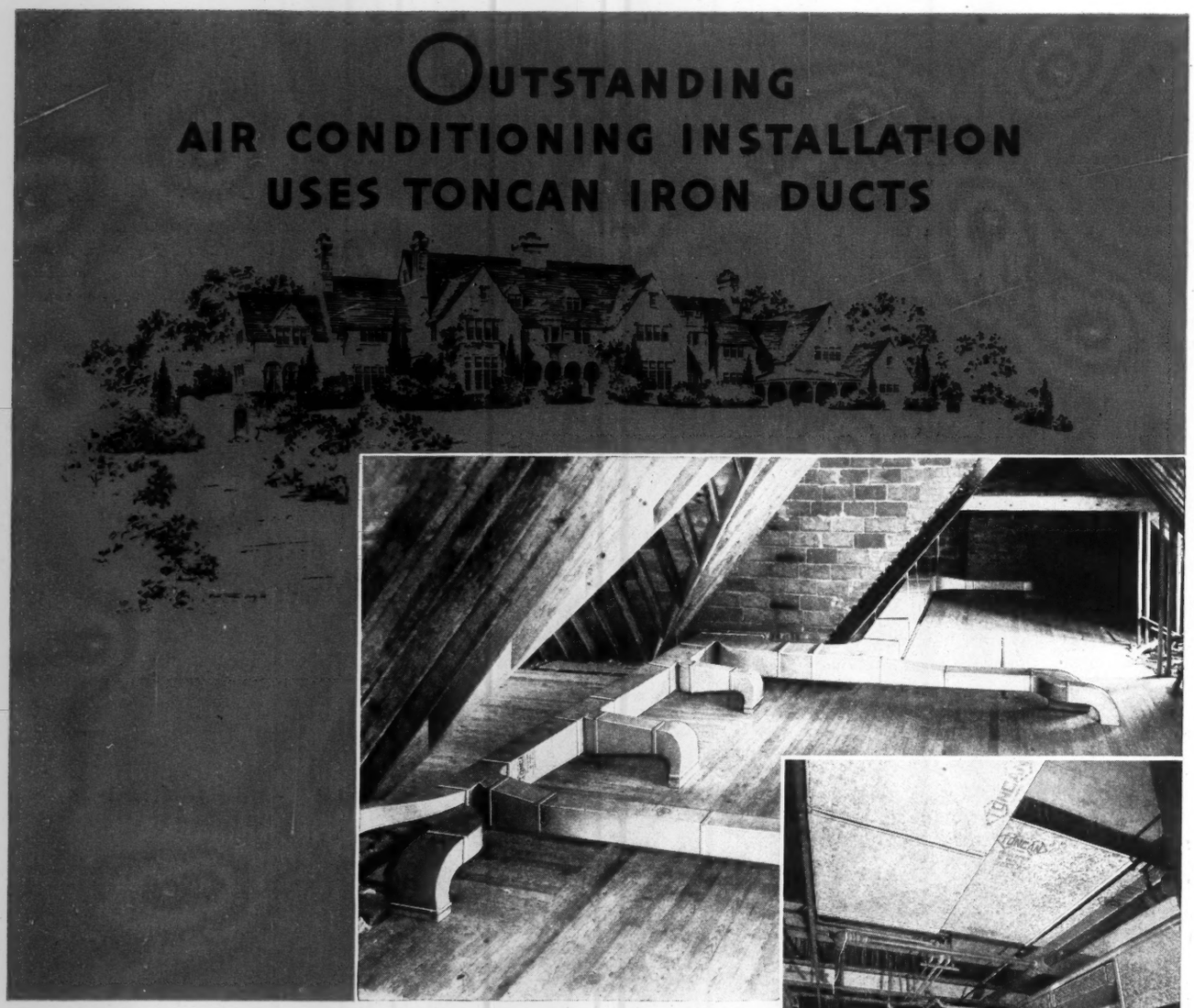
THE fastest moving pictures in the world, made at the rate of 6000 per minute, were taken in connection with the litigation in the United States district court at South Bend, Indiana, over the granulated household soap business. . . In the spray drying method of manufacture, hot soap under pressure is blown into a drying tower, takes form in a blast of hot air, and dries as it falls to the bottom. . . The case is said to establish a precedent in the completeness of the preparations and the scope of the testimony and the exhibits. . . Walter L. Fleisher, Consulting Engineer, has been one of the expert witnesses on spray drying.

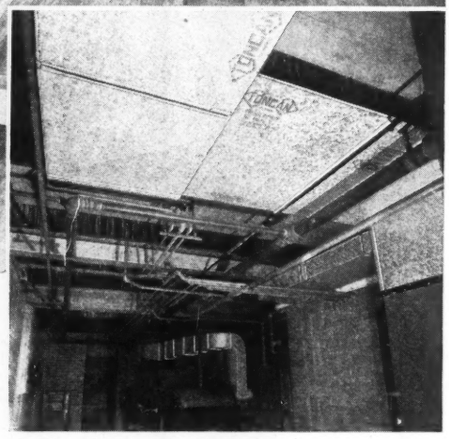
OBSOLESCENCE of plant equipment and its necessary modernization represent a tremendous potential stimulus to business and the capital goods industries, it is felt by many. . . Of prime importance to industry is replacement of out-worn, inefficient heating systems, modernization offering opportunities for worthwhile savings in operating cost and improved service, as many actual examples have proved. . . New and improved unit heaters developed by several manufacturers are particularly suitable for modernization, as are systems for better control of temperatures. . . One of the most fruitful fields for heating modernization is the small apartment building, where temperatures are notoriously way too hot or way too cold. . . Service and consequent tenant satisfaction can be greatly improved, cost and complaints greatly lowered, with moderate expenditures for needed repairs and replacements. . . One apartment building operator computes degree days on a 70 F (instead of the standard 65 F) base for comparing fuel consumption for apartment building heating. . . It's more accurate, because heat "control" is by opening windows, warming up the outdoors with expensive heat.

A PROPOSED American Standard for pressure and vacuum gages has recently been completed, is in tentative form for discussion, and criticism and comment are welcomed. . . Communications should be addressed to C. B. LePage, assistant secretary of the *American Society of Mechanical Engineers*, 29 W. 39th St., New York City. . . A petroleum section has been formed by the Special Libraries Association to bring in closer contact librarians dealing with petroleum and allied subjects; facilitate inter-library loans; exchange duplicate material. . . Interested librarians may write Albert Althoff, General Petroleum Corp., of California, 2525 E. 37th St., Los Angeles. . . This issue contains the volume index for Vol. 6 of HEATING, PIPING AND AIR CONDITIONING, January-December, 1934, as well as the yearly index for the Journal Section of the *American Society of Heating and Ventilating Engineers.*

ALL national industrial organizations not yet represented are urged to communicate with the *American Standards Association* regarding representation on the exhaust code committee of the *A. S. A.*, scope of which is the elimination of injurious dusts, fumes, and gases at the point in any industrial process where they are generated. (Matters of general ventilation come under the ventilation code). . . A proposed simplified practice recommendation covering steel horizontal firebox heating boilers has been mailed to interests in the industry by the division of simplified practice of the National Bureau of Standards for consideration and written approval. . . Approved at a conference in Cleveland last June, it lists 19 sizes of boilers from 1800 to 35,000 sq ft of steam and 2880 to 56,000 sq ft of water radiation for hand firing. . . Nineteen ratings are also given for these boilers mechanically fired, from 2190 to 42,500 sq ft steam, and 3500 to 68,000 sq ft water radiation.

OUTSTANDING AIR CONDITIONING INSTALLATION USES TONCAN IRON DUCTS





Attic and basement views of air conditioning system in the residence of H. J. Lacy, Sr., Indianapolis. Architect: H. L. Simons. Air conditioning system designed, fabricated and installed by T. A. Mulrey & Son, Indianapolis.

The 52-room residence of H. J. Lacy, Sr., in Indianapolis, was changed during construction from a vapor heating system to an air conditioning system without requiring a single construction change. More than one hundred outlets and returns were required with ducts from basement to attic.

Because of its proved resistance to rust, more than four tons of Toncan Iron was fabricated and installed in this home. It was used in the trunk and branch ducts, fittings, dampers and flue breeching.

Toncan Iron is ideally suited to air conditioning work where varying degrees of moisture in the air are conducive to rapid failure of ordinary ferrous metal. But Toncan Iron is an extraordinary metal—a true alloy of refined iron, copper and molybdenum. It resists rust better than any of the ferrous metals with the exception of the stainless steels—and lasts longer. It speeds up installation, because it fabricates easily. And it is quickly available from distributors' stocks in practically all large cities.

If you have not read the story of Toncan Iron in "The Path to Permanence," write for a copy today.

TONCAN COPPER MO-LYB-DEN-UM IRON

REPUBLIC STEEL CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

Heating · Piping and Air Conditioning

BOARD OF CONSULTING & CONTRIBUTING EDITORS

Heating—Samuel R. Lewis, Alfred J. Offner, E. B. Langenberg, James C. Peebles, John D. Small, Homer R. Linn, Lee P. Hynes, Frederick D. Mensing, R. P. Schoenijahn, A. K. Ohmes, J. C. Hornung, A. Beaurrienne, T. S. Tenney.

Piping—A. W. Moulder, Sabin Crocker, R. C. Doremus, David J. Jones, George B. Mulloy, J. J. Harman, C. W. Kimball, A. R. Acheson, Percy R. Owens, E. L. Ellingwood, W. H. Wilson.

Air Conditioning — Dwight D. Kimball, Walter L. Fleisher, John Howatt, Charles S. Leopold, Frank B. Rowley, Alfred Kellogg, John F. Hale, E. P. Heckel, H. C. Murphy, Philip Drinker, R. S. Hawley, William A. Hanley, Edgar S. Miller.

Editor—Chas. E. Price—*Engineering Editor*—C. M. Burnam, Jr.

Published monthly by the Keeney Publishing Company, 6 N. Michigan Ave., Chicago (Telephone: State 6916). F. P. Keeney, President; W. J. Osborn, Vice-President; R. Payne Weftstein, Secretary; Chas. E. Price, Treasurer. Address all correspondence to Chicago office. New York office, Room 1735, Grand Central Terminal Bldg. (Telephone Murray Hill 2-8293). Cleveland office, 2047 Rossmoor Road (Telephone: Yellowstone 1540). Subscriptions $2.00 per year anywhere in the world. Current copies 25c each, back copies 50c each. Member of Audit Bureau of Circulations and The Associated Business Papers, Inc.

Copyright, 1934, by Keeney Publishing Company.

Advertising Staff — W. J. Osborn, R. Payne Weftstein, R. A. Jack.

Cool and consequently supposedly comfortable are these babies in the air conditioned nursery at the Memorial hospital, Houston, Texas. The cooling unit as installed last summer, has proved its worth in protecting babies from the heat and ailments due to excessive heat, it is reported. (Photo, Ilg Electric Ventilating Co.)

CONTENTS *for* DECEMBER, 1934

Vol. 6, No. 12 • Pp. 497-542

Consulting Engineer Surveys Theater Heating and Air Conditioning—Finds Need for Modernization, by D. D. Kimball 497

Production Methods in Pipe Welding for Plant Construction, by G. E. Deatherage and J. B. Latterner 500

When Does Building Insulation Pay? by Paul D. Close 501

Piping Layout and Steam Pressure Control in Steam Generating Plants, by E. C. Gaston 506

Choosing the Right Air Conditioning System, by A. Warren Canney 508

Methods of Installing Refrigeration Piping, by Robert S. Wheaton 512

Index for 1934 (Vol. 6, Nos. 1-12) 537

"In the News" 542

The Editor's Page (front section) 23

Correspondence (back section) 74

Book Reviews (back section) 76

Equipment Developments (back section) 78

Recent Trade Literature (back section) 86

Index to Advertisers (back section) 88

Journal Section of the American Society of Heating and Ventilating Engineers

The Heat Requirements of Buildings, by J. H. Walker and G. H. Tuttle 515

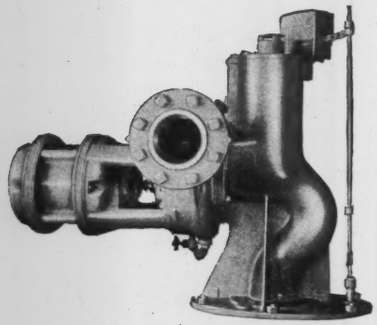
Some Recent Studies on the Ashes in Coal, by Thos. G. Estep 520

Educational Activities of the St. Louis Chapter, by Paul Sodemann 524

Nominations for 1935 527

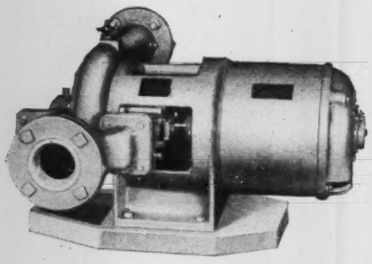
Going to Buffalo? 528

Bulletin Section 530



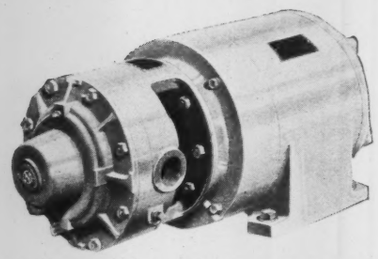
JENNINGS SUMP & SEWAGE PUMPS
PEDESTAL TYPE

Mounted entirely above the pit cover. Entirely self-priming. All working parts high and dry Only suction pipe submerged. Economical.



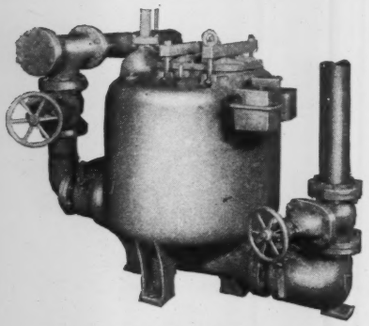
CENTRIFUGAL PUMPS
STANDARD AND SELF-PRIMING

Motor armature and pump impeller mounted on same shaft. No bearings in pump casing. One stuffing box. Simple, compact, reliable.



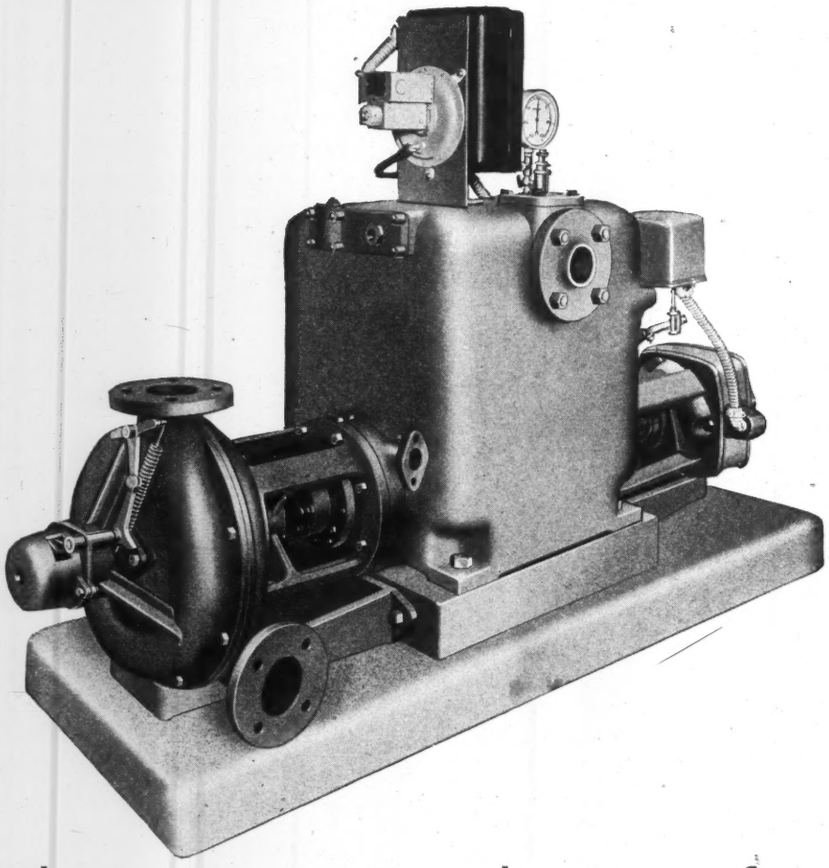
NASH HYTOR AIR COMPRESSORS

No sliding vanes, pistons nor parts in metallic contact. No internal lubrication. Non-pulsating. Clean air. Efficient and reliable.



JENNINGS SEWAGE EJECTOR

Most efficient device for pumping unscreened sewage from low levels, or pumping any heavy liquid with large proportions of solids.



There Is a Nash Unit for Every Pumping Service

There is a reason for the many thousands of installations of Nash Pumps. For over twenty years the name Nash has stood for reliability in pumping equipment. From the complete Nash line it is possible to select a superior pump for practically any service.

One of the newer members of the Nash Pump family is the Vapor Turbine Return Line Heating Pump above. Here is a pump that not only eliminates the cost of electric current, but promotes greater efficiency in your heating system than any other type of Heating Pump.

It can do this because it functions on a new system of controlled continuous operation, and is the only heating pump that can operate continuously with economy. Any Engineer knows that continuous removal of air and condensate means efficiency in a heating system.

Why not write us today for Bulletin 203 which gives all of the interesting details?

NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

IT'S LEAKPROOF!

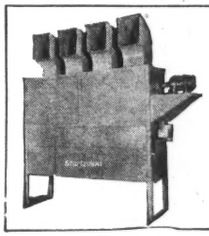
...this heating element

in a **Sturtevant** SPEED HEATER

Here's a heating element that you can forget as far as leaks are concerned. It's absolutely leakproof. Note how the tube of each section of extended surface is connected to the header. Each joint is made permanently tight by a special method developed by Sturtevant.

GUARANTEED FOR 200 LBS. PRESSURE

Heating elements guaranteed for all steam pressures up to 200 lbs. per sq. in. are standard equipment in Speed Heaters.



STURTEVANT REXVANE HEATER

For floor, wall or ceiling installation. Built in a wide variety of types and sizes, ranging from 100,000 to 1,000,000 B.T.U.

TIME-SAVING INSTALLATION

You can connect up to either side of a Speed Heater. No need to bring supply line around the heater. Saves time, labor, pipe.

WE SUPPLY THE HANGERS

And save you time and expense. They're handy hangers of malleable iron all ready to be formed in your vise to fit installation conditions.

MULTI-SPEED MOTORS

A big advantage. Provide up to 5 speeds, depending on characteristics. High speed for extra-fast heating. Lower speeds are used for set normal temperatures.

QUICK SHIPMENT

Most popular voltages stocked in many locations. Other standard voltages stocked at Hyde Park.

SEND FOR COMPLETE DATA

B. F. Sturtevant Company, Hyde Park, Boston, Mass.

☐ Send me Sturtevant Speed Heater Catalog No. 396.

☐ Have your nearby representative call.

*Name*_____

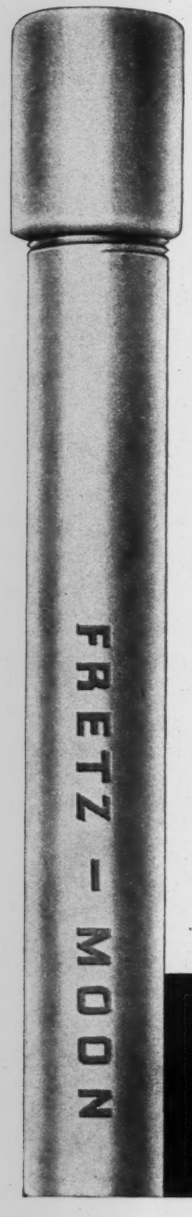
*Company*_____

*Address*_____

H. P. 12-34

THERE IS NO BETTER STEEL PIPE

● For highly corrosive conditions or where exceedingly high pressures are encountered, it is only logical and good practice to use alloy or stainless steel pipe made by special processes . . . but for ordinary installations where Bessemer steel will meet the requirements, it is logical and more economical to use steel pipe. And the experience of users bears us out in the statement that there is no steel pipe better than Fretz-Moon.



Fretz-Moon Steel Pipe is different from other steel pipe because it is made differently—by the exclusive, scientifically controlled "continuous process." And because it is made of specially selected steel by this same process, it possesses high degrees of uniformity, ductility and cleanliness not found in steel pipe made by ordinary methods.

The story of the "continuous process" and why Fretz-Moon Pipe is better is contained in an interesting little booklet, which will be sent to you upon request.

FRETZ-MOON TUBE COMPANY • INC.
BUTLER, PENNA.

FRETZ-MOON PIPE
BLACK AND GALVANIZED

The Editor's Correspondence

Steam Consumption for Plant Heating

THE EDITOR: We are very much interested in the steam consumption data furnished in the article on the modernization of the heating system of the Bausch & Lomb plant in the October H. P. & A. C. giving the value of degree days for 1933 and 1934 for the months of January, February, March, April and May. Would there be available similar data for the fall months of 1932 and 1933?—H. F. G. (Rayon Company).

The steam consumption data requested is:

Month	Degree Days	Steam Consumption Lb	Lb Steam/Deg Day
October, 1932	356	3,082,500	8,659
November, 1932	819	9,209,900	11,245
December, 1932	968	11,059,500	11,425
January, 1933	910	10,323,800	11,345
February, 1933	1,018	11,919,300	11,708
March, 1933	1,004	11,802,700	11,755
April, 1933	537	5,843,900	10,883
May, 1933	187	1,716,600	9,180
	5,799	64,958,200	11,202 Ave.

During the 1932-1933 heating season Building No. 14 was under differential vacuum operation and was showing a saving of 1060 lb of steam per degree day as compared with previous operation. This saving must therefore be added to the consumption rate for the 1932-1933 heating season in order to obtain an exact comparison before any changes were made in the heating equipment.—Gray D. Dickason, Mechanical Engineer.

Silica Gel for Air Conditioning

THE EDITOR: What is silica gel, and how is it used in air conditioning?—F. J. R.

Silica gel is a hard, glassy material made from sodium silicate and acid, and having the same chemical analysis as sand (SiO_2). It differs in structure from clear quartz sand in that the crystals are highly porous, the voids constituting 41 per cent by volume, although the pores are microscopic in size. Through the power of adsorption (a phase of capillary attraction) this material possesses the property of removing moisture from the air, thereby dehumidifying air. Dehumidification is, of course, required in air conditioning for industrial processes, and in air conditioning for human comfort.

After the silica gel has become saturated through adsorption of moisture, to the limit of its capacity, the moisture may be driven off by the application of heat, and reactivated for further use. Reactivation is necessary after the silica gel has absorbed about 25 per cent of its own weight of moisture. This reactivation is usually done by means of gas or oil fires, and the silica gel beds are cooled before further use in adsorption of moisture because silica gel is only active at low temperatures, and reactivation requires high temperatures.

A paper published in the *Journal Section* of the *A.S.H.V.E.* in the November, 1932, H.P.&A.C. described the use of silica gel in an air conditioning plant for maintaining low humidity required during the manufacture of telephone cables. You will notice in this article some information about silica gel and how it is used in air conditioning.

Reversed Refrigeration Cycle for Heating

THE EDITOR: I like the frosting on my cake thick. So let's not throw away any frosting we have already made—but put it all on the cake.

I have, just recently, read the articles by C. F. Mowrey on the reversed refrigeration cycle for heating, which appeared in the June and July numbers of H.P.&A.C. with more than just a passing interest. I did so because I have been interested in establishing the possibilities of the reversed cycle for heating in

this area. The thermodynamics of the system proposed is quite fascinating and, seemingly, offers considerable advantage over a system employing a prime mover which has a high thermal efficiency.

If I remember my thermodynamics correctly, advantage was not taken of as large coefficient of performance for the proposed system as might have been. With a gas temperature of 20 F in the evaporator and a mean temperature of 99 F in the condenser, the coefficient of performance (C.P.) for the reversed cycle (that is, when used for heating) would be:

$$\text{Theoretical C. P.} = \frac{460 + 99}{99 - 20} = 7.08$$

Using the assumed efficiencies given in the article for the condensing unit and engine, we have:

$$\text{Actual C. P.} = 0.15 \times 7.08 = 1.06$$

By a "cut and try" method, it is found that a heat pump of 80,000 Btu/hr, or say 7 tons, capacity and an 8 hp engine will supply the 125,000 Btu/hr required.

Comparing these results with those from the author's first calculations, it is noticed that the condensing unit has been increased from 5 to 7 tons while the engine power was reduced only 0.8 hp. So it may be that the additional "frosting" didn't help the "cake" much.

I should like to have Mr. Mowrey's reaction to this correction. Will also welcome any ideas he might suggest for the cycle in this area where there are not over one or two days during the average heating season when the temperature falls below 25 F. Mean during heating season about 45 F.—M. T. (Tennessee Valley Authority).

About that frosting on the cake—none of it was wasted, but the amount that it appeared might be added to the top had already been put between the layers.

Referring to the article in the June H.P.&A.C. in computing the theoretical coefficient of performance, I used the equation $\frac{460 + 20}{99 - 20}$ instead of $\frac{460 + 90}{99 - 20}$ because I had already accounted for the heat represented by the difference between the 90 F and the 20 F, although it may not have been made quite obvious.

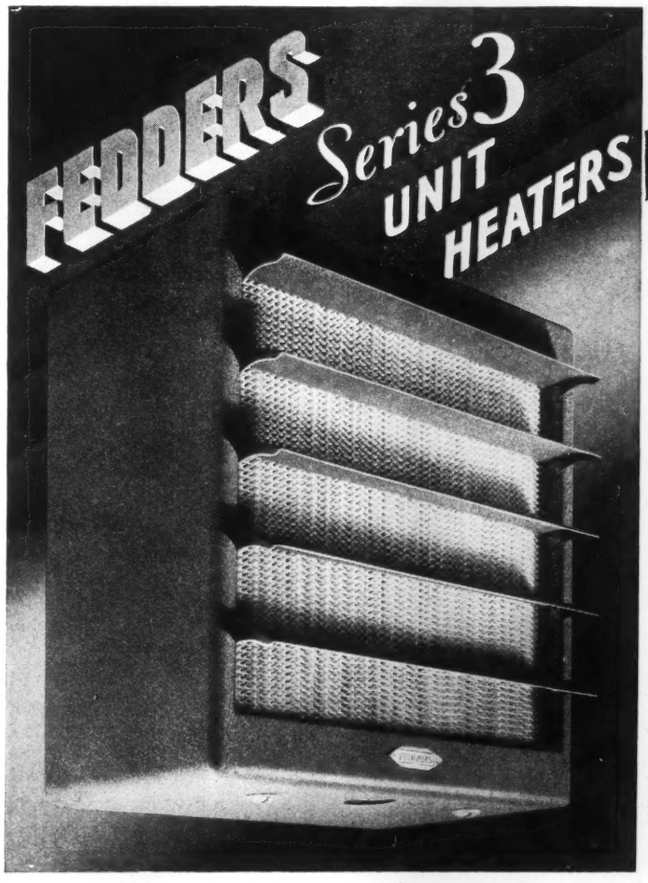
The heat represented by this difference is heat that would not have been absorbed in the evaporator but would have been produced by the work done on the refrigerant. All of this work would produce heat in the compressor, but due to the fact that a certain amount would be lost by radiation, convection and conduction, in a manner that would not render it recoverable, I accounted for it in the last paragraph in the first column of page 259, in the summation of the percentage of "waste heat" recoverable.

This paragraph stated, "The 25 per cent of the heat input that goes into power is ultimately converted back to heat and mostly at the heat pump. We will consider that 0.4 of this 25 per cent could also be utilized as heat, which means an additional 10 per cent." In other words, I allowed 0.6 of this heat as an unavoidable loss to the outside air, in order to prevent drawing any gas or lubricating oil fumes into the warmed air supply.

I trust this will clear up the apparent discrepancy.

Regarding the use of such a cycle, in the Tennessee Valley, I trust you are more interested from the electrical angle. Personally, I am neutral on the subject, having written an article on this from the electrical angle, which was published in the September, 1930, issue of the *N.E.L.A. Bulletin*.

If an electric motor were to be used to drive a compressor no exhaust heat would be available to add to the upper part of the temperature range, but on the other hand, in such a climate the condenser gas temperatures of 87, 99 and 111 F would probably be high enough for a properly designed system. Incidentally, due to superheating of the gas during compression, the actual tem-



SELLING AS GOOD AS THEY LOOK

● First we told you that Fedders Series 3 Unit Heaters are built as good as they look. Now we tell you that they are *selling* as good as they look.

Whether you sell, specify, install, or use Unit Heaters,—learn how Fedders handsome, sturdy cabinets, —streamline tubes—patented fin construction—full floating heating element — resilient motor mountings—quieter operation, are making them sell from Boston to Seattle. Catalog No. 527 takes them apart for you,—mail the coupon for your copy right now.

FEDDERS MANUFACTURING COMPANY
BUFFALO, N.

Please send me the Catalog that takes Series 3 Unit Heaters apart for me. HP12

Name .....

Concern .....

Street ..... City .....

Pat. 1,970,105

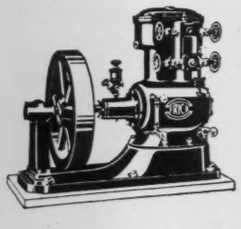
Better Lubrication for Compressors

with TRADE FRICK MARK

Refrigerating Machine OIL

Protect your compressors just as you do your automobile—with an oil refined especially for the service. And remember that a refrigerating machine in a year and a half of continuous operation turns over more times than the average auto engine during its entire life!

Frick Refrigerating Machine Oil is rich in lubricating value. Being a straight mineral oil, thoroughly dehydrated, it is chemically stable, forms no acids nor gummy deposits, and will not vaporize at working temperatures. Backed by our half century of experience in refrigerating machine work.



Frick Oil is available in three weights, numbered 2, 3, and 4. It is packed in 30 and 55 gallon drums, and in one and five gallon cans.

In ordering, state the size, type, and make of your refrigerating machine, also its operating speed, pressures and the refrigerant used. The nearest Frick Branch or Distributor will cheerfully supply you.

Frick Company
WAYNESBORO, PA. U.S.A.
ICE MACHINERY SUPERIOR SINCE 1882

peratures in the condensers would be somewhat higher than the theoretical temperatures.

The average temperature at which the heat would be picked up during the heating season would probably be about 35 F. Considering 25 F for the evaporators and 87, 99 and 111 F or an average of 99 F for the condensers, the theoretical C. P. would be $\frac{460 + 25}{99 - 25}$ or 6.55 plus the heat generated as a result of the work done, or 7.55. Undoubtedly, the actual C.P. would equal half of this figure or about 3.8.

I would be greatly interested in any use you might make of this system.—C. F. Mowrey, Oswego Dist., Niagara Hudson Power System.

Books on Hot Water Heating

THE EDITOR: Please send me the names of the latest books on hot water heating.—G. A. P.

Replying to your request for the names of the latest books on forced circulation and hot water heating, we would suggest the *Guide of the American Society of Heating and Ventilating Engineers.* The third edition of "Heating and Ventilation," by Allen and Walker has a chapter on hot water heating systems by Professor F. E. Giesecke—his research work has made him an outstanding authority in this field.

Book Reviews

Manual for Engineer-Custodians

"Engineer-Custodian's Manual", by Thomas J. Brett, published by the American Technical Society, Drexel Ave. at 58th St., Chicago. 192 *pp.*, 5½x8½, *clothbound.* $2.50.

The author, engineer-custodian for the Chicago board of education, has assembled in this helpful book over 500 questions and answers on heating and ventilating, boilers and combustion, engines, pumps, electrical machinery, mechanics, plumbing, and sanitation, supplemented by some 200 engineering formulas and tables. It is a book for practical men—building managers, engineers, custodians, firemen, caretakers, and electricians—written by a man with practical experience and one who has instructed classes for those studying for competitive examinations. His book has been planned to be of aid to those taking civil service examinations, and to assist in handling the engineer-custodian's job more efficiently.

The section on heating and ventilation is one of the most complete; among the topics considered are radiation for direct and indirect heating, requirements for educational buildings, air flow in ducts and fans, maintenance of vacuum, vacuum pump capacity, heat and ventilation losses, causes of vitiated air, proportion of pure and respired air, heating requirements of buildings, fan and piping data, pipe heater data, etc.

Handbook of Chemistry and Physics

"Handbook of Chemistry and Physics" (19th Edition), compiled by 200 experts under the direction of Chas. D. Hodgman, published by The Chemical Rubber Pub. Company, 1900 *W. 112th St., Cleveland, Ohio.* 1,934 *pp.*, 4½x7, leatherbound. $6.00.

The latest edition of this standard handbook contains a number of additional tables, among which are density of moist air, heat of combustion of liquid fuels, thermodynamic properties, and a number of others of interest to the heating, piping or air conditioning engineer. Many of the tables which appeared in previous editions have been revised. In all, 89 pages have been revised and 95 new pages added.

The handbook has been divided into five sections to facilitate its daily use; these are: mathematical tables; properties and physical constants; general chemical tables; heat and hygrometry, sound, electricity and light; and quantities and units—miscellaneous tables.

A Textbook on Heat

"Heat," by James M. Cork, Associate Professor of Physics, University of Michigan. Published by John Wiley & Sons, Inc., New York City. 279 + xi. pp. 6x9, clothbound. $3.00.

Like other branches of physics, the subject of heat has undergone in recent years a remarkable development. The presentation of this newer material together with the older classical treatment of the subject enlarges greatly the content of a satisfactory course for advanced students, states the author in his preface. As this widened scope renders the source of material so varied, students have felt the need of an adequate text surveying the field. It is to meet this need that "Heat" was written and published. The aim has been to present in not too detailed manner the complete development of the subject, lengthy descriptions of classical experiments being avoided but complete references to original papers being given.

Primarily a text for students of physics, this book contains a great deal for the practical engineer with a training in fundamentals. Particularly to those who are desirous of keeping in touch with an ever-advancing subject is it recommended. Inherently a subject which needs study to comprehend, the author facilitates grasping of the fundamentals by a clear style and a logical arrangement of the text matter.

Chapter I is concerned with the Measurement of Temperature, followed by a chapter on Specific Heats; the other chapters, in their order, are:—Thermal Expansion; Transfer of Heat—Conduction and Convection; First Law of Thermodynamics—Energy Equivalence; Radiation; Change of State; Continuity of State; Introduction to Thermodynamics; Production of Low Temperatures; and Production of High Temperatures. An appendix presents pertinent tabular information.

Equipment Testing Reference

"Power Plant Testing", (4th Edition), by James A. Moyer, published by McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York City. 614 pp., 6x9, clothbound. $5.00.

This volume is a manual of testing steam generating equipment; engines, turbines, pumps, refrigerating machinery, fans, fuels, lubricants, etc., the fourth edition being extensively rewritten and enlarged. An unusually complete index facilitates its use as a reference handbook in the testing of equipment.

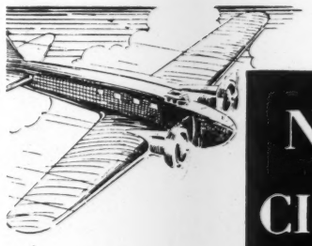
Since the last revision of this book, power plant testing has become increasingly exact, chiefly because of the introduction of higher steam pressures. Consequently, several new codes and methods are incorporated in the book.

Among the twenty-five chapters into which the book is divided are included measurement of pressure; measurement of temperature; flow of fluids; calorific value of fuels; flue-gas analysis; testing of boilers; testing of ventilating fans or blowers and air compressors; testing of refrigeration plants; testing atmospheric water-cooling equipment—cooling towers, spray nozzle installations, and cooling ponds; and tests of hydraulic machinery.

Formulas for Natural Gas Pipe Lines

"Formulas for Designing Natural-Gas Pipe-Line Systems Consisting of Parallel Lines," (R. I. 3241), by T. W. Johnson and W. B. Berwald, issued by the United States Bureau of Mines. 12 mimeographed pages, 8½x11.

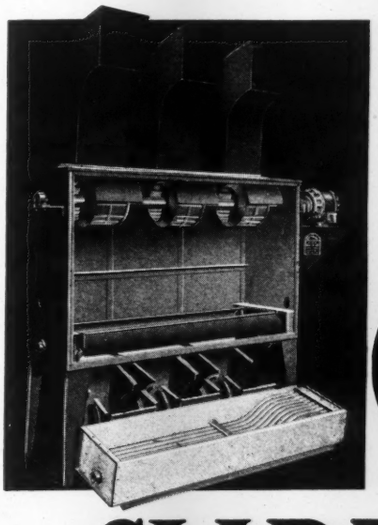
This report represents work done by the Bureau in cooperation with the State of Oklahoma. According to the introduction, small increases in demand for natural gas can usually be met by increasing operating pressures but for any marked increase, paralleling sections of existing systems is necessitated. The report consequently presents formulas and curves derived from Weymouths' formula (without the detailed derivations) and discusses the fundamentals of design and the economics of parallel line systems briefly. A number of typical problems worked out with the data given are included.



NON-STOP CIRCULATION of WARM AIR

You Can Profit from this Patented Feature

- A unit heater is many times more efficient than direct radiation simply because its fans in operation circulate the heat produced. But when the ordinary unit heater has brought the room temperature up to the desired point, the thermostat stops the fans.
- When the fans stop, stratification starts. Cold air drops to the floor. Warm air rises to the ceiling. Fuel is wasted—plenty of it—an expensive method!
- But in factory heating THERE IS a better way to regulate temperatures! It is Clarage Syncrotherm Control—not only better, but far cheaper.
- With Syncrotherm Control, the fans operate ALL THE TIME during working hours. You get a CONTINUOUS NON-STOP circulation of warm air.
- To maintain desired temperatures, instead of stopping and starting the fans, we regulate the amount of air passing through and around the heating coil. The advantages and economies of Syncrotherm Control are amazing, and it's offered on Clarage Unit Heaters AT NO EXTRA COST.



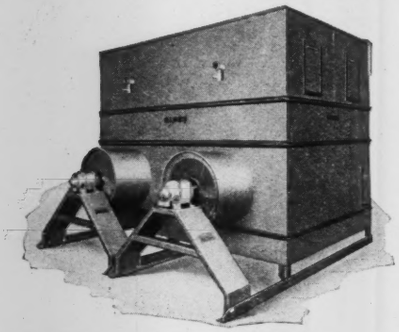
- Clarage Units are built in practical sizes for every industrial need. Coil removable and all parts accessible as shown. Write for Bulletin 103. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

Syncrotherm Control IS STANDARD ON

CLARAGE

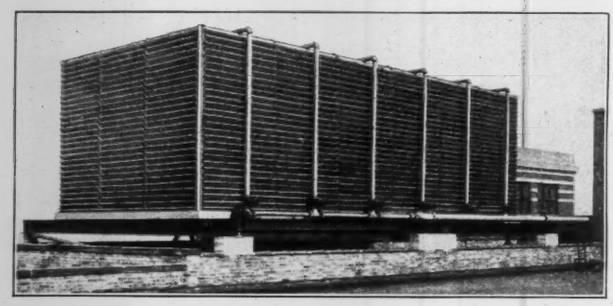
UNITHERM UNIT HEATERS

COOLING TOWERS AND SPRAY NOZZLES

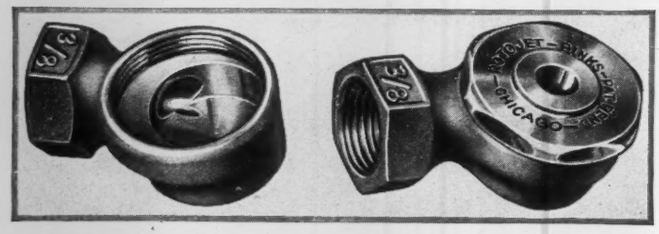


The First choice of Air Conditioning Engineers Everywhere

BINKS



BINKS Atmospheric Spray Cooling Towers—built in sizes from 6 to 200 tons refrigeration capacity—as well as Indoor Forced Draft Cooling Towers up to 40 tons capacity, are now used extensively in connection with the rapid march of progress being made in the Air Conditioning field.
BINKS offers a standardized complete shop constructed Tower (with full spray nozzle distribution) for almost every application, as will be evidenced by more than 2,000 Binks Cooling Towers now in operation.
BINKS patented "ROTOJET" Clog-Proof Spray Nozzles likewise are contributing mightily to the increased Air Washing efficiency now in demand.
The Binks line—recognized as being the most complete—includes spray and atomizing nozzles of advanced design for practically every industrial application.
Valuable data on request.



ROTOJET Nozzles furnished in sizes from 1/4" to 2 1/2" pipe connections. Nozzle with cap removed shows involute whirl chamber.

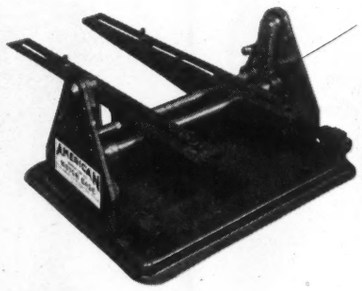
BINKS MANUFACTURING COMPANY
3106 CARROLL AVENUE
CHICAGO, ILL.

Equipment Developments

For your convenience in obtaining more information about any of this equipment, see coupon on p. 87

New Motor Base for Controlling Flat Belt Drive Tension

No. 124. New tension control motor base for short center belt drives automatically produces a belt tension always in proportion to the load—increasing tension when peak loads develop and decreasing tension when power to be transmitted is reduced—by utilizing reaction torque of motor frame. The motor is suspended in a cradle free to rotate through a limited range. The pivot axis of the cradle is placed close to the motor axis in order to obtain the maximum reaction effect, yet far enough removed so that when the motor swings about the axis it increases center distance enough to compensate for belt stretch and vary the tension with each change in load. This base affords a complete



range of application for floor, wall, ceiling and with attachments for driving downward. Advantages of its use are those resulting from lower average belt tension, such as longer belt life, reduced power loss, and a saving in bearing maintenance, states the manufacturer.

The construction is of pressed steel. The only moving parts are the cranks supporting the motor and cradle arms which are steel forgings equipped with graphite bronze bearings requiring no lubrication. The bases are made in eight standard sizes, can be obtained in special dimensions if required. A recently issued bulletin explains the principle of operation, advantages, method of mounting, selection and dimension tables, etc.—The American Pulley Company, 4200 Wissahickon Ave., Philadelphia, Pa.

New Units for Low Temperature Air Conditioning

No. 125.—New line of cold diffusers for cold storage refrigeration have capacities from 1 to 30 tons according to type of application. Special features include hot-dipped galvanized treatment of all principal parts to prevent corrosion; new design low velocity outlets distributing air in all directions; new centrifugal fan which handles the same amount of air with less horsepower than previous models; sectional construction of units to permit top or side discharge of air, and fin-type cooling coils for methyl chloride, freon or ammonia.

The units, of floor mounted type, are made in three sizes.

Advantages claimed are positive air circulation; adequate and varied means of air distribution; surface cooling (with the addition of sprays in one model); automatic control of temperature and room conditions, maintenance of high relative humidities when desired; automatic control of defrosting when the room conditions are 33 F or above; equipment adaptable to a variety of refrigerants; flexibility of application to variations in storage room layout.

The equipment is applicable to new installations or for replacement of bunker coils in beverage plants, canning and pre-

ANNOUNCING

A COMPLETE LINE OF

DIRECT EXPANSION COOLING UNITS

BY

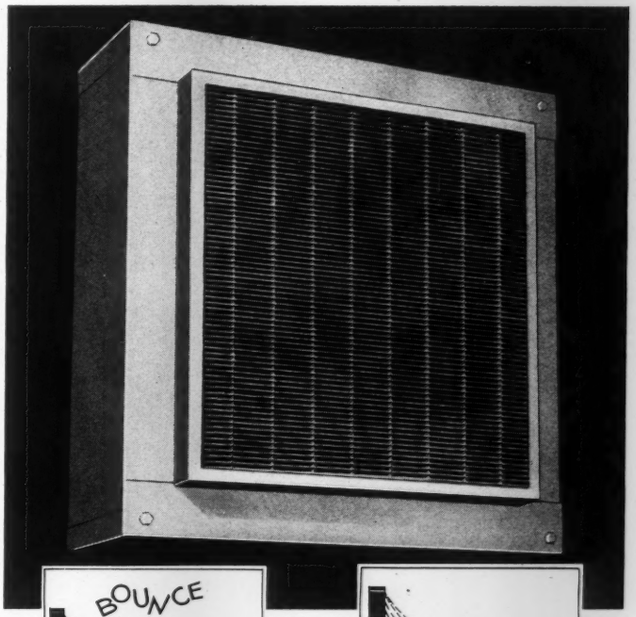
AEROFIN

Comprehensive information for architects and engineers in handling cooling problems is now available in our new bulletin describing Aerofin Standardized Light Weight Fan System Cooling Surface.

Send for your copy today. Ask for Aerofin Cooling Bulletin DE-34. Address Main Office Newark or any branch office or Aerofin Distributor.

AEROFIN is sold only by Manufacturers of Nationally Advertised Fan System Apparatus. List upon Request

AEROFIN CORPORATION
850 FRELINGHUYSEN AVENUE
NEWARK, N. J.
CHICAGO DETROIT NEW YORK PHILADELPHIA



Conventional Unit Heater Airstream

"Floor Line Spread" Heater Airstream Wherein the Bounce Is Eliminated

A Revolutionary Heating Development

Trane's New "Floor Line Spread" Unit Heater Solves An Old Heating Problem

Trane announces a practical unit heater development—and the solution of an old heating problem, that of the proper distribution of heated air. The Trane "Floor Line Spread" unit heater is especially designed to properly direct air currents—to spread heat along the floor line, where it will mix easily with cool air, and be properly distributed.

The ordinary louver type unit heater fails to do this. The air stream from this heater bounces off the cool air near the floor, then rises to the ceiling, above the human working area. This is the result of two conflicting forces, two separate air streams which fight one another.

Trane solved this problem by eliminating the conflict of air streams. With Trane's "Floor Line Spread" unit heater there is only one force, that which directs heat downward, along the floor line.

We will gladly send you, free of charge, a copy of a booklet explaining the many advantages of the "Floor Line Spread" heater. Mail the coupon below.

THE TRANE COMPANY,
La Crosse, Wisc.
Dept. 11

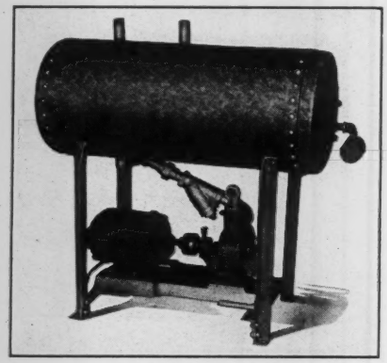
Please send me copy of the booklet "Trane 'Floor Line Spread' System of Unit Heating."

Name.....

Address.....

City.....State.....

TRANE UNIT HEATERS



The M-K-O Automatic BOILER FEED

Maintains a Constant Water Level in High or Low Pressure Boilers "Automatically."

All Feed Water worries are eliminated when the M-K-O Boiler Feed is used because it: Automatically pumps the feed water against high boiler pressure — Returns the condensate to the boiler —Supplies make-up water as required. This Unit uses no steam. It can be used with Gas, Oil, Stoker or Hand-fired Boilers.

Ask for literature and prices.

NOTE: We also manufacture the well known Kane Fire-Tube Automatic Gas Steam Boiler and the Ofeldt Water Tube Gas-Fired Steam Boiler. Literature upon request.

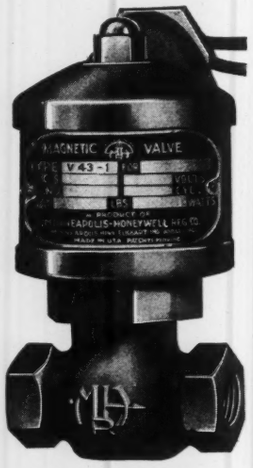
MEARS-KANE-OFELDT INC.

Executive Office and Factory
1903-1915 EAST HAGERT ST., PHILADELPHIA
Branch Offices or Distributors in Principal Cities

AIR CONDITIONING CONTROLS

for

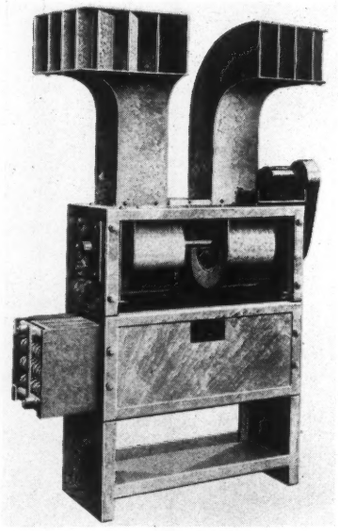
Domestic or Commercial Installations



Magnetic Shutoff Valve. Silent Solenoid valve with replacement seat and plunger. Especially designed for domestic air washers.

MINNEAPOLIS-HONEYWELL Air Conditioning Controls govern all phases of this work, including heating, cooling, ventilating, humidifying or dehumidifying. There are controls for every application, each designed to accomplish its particular function with characteristic Minneapolis-Honeywell accuracy and efficiency. Minneapolis-Honeywell Regulator Company, 2701 Fourth Avenue South, Minneapolis, Minn. Branch and distributing offices in all principal cities.

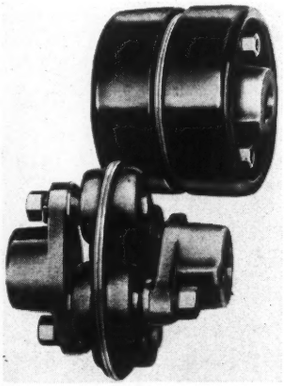
MINNEAPOLIS-HONEYWELL
Control Systems



serving, confectionery, dairy products, ice cream, manufactured ice, meat and meat products, vegetable and fruit storage, furs, etc.—Carrier Engrg. Corp., 850 Frelinghuysen Ave., Newark, N. J.

Rubber Is Flexing Medium in New Coupling

No. 126.—Industrial flexible coupling ("Morflex") depends upon rubber as flexing medium, there being no movement of metal on metal or metal on rubber. Coupling consists of two forged steel hub members mounted on the shafts to be connected between which is carried the floating center to which each hub is separately connected through a pair of resilient rubber trun-



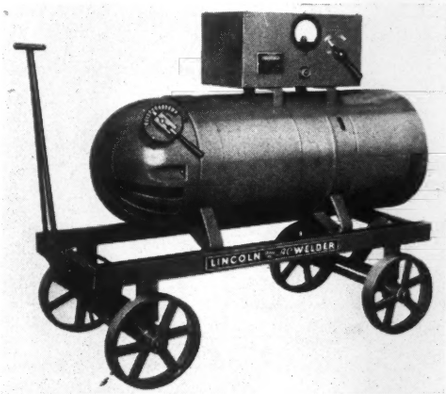
nion blocks. The blocks, 90 deg apart, are set under pressure into a two piece riveted housing of pressed steel. The rubber blocks, of specially developed resilient non cold flow rubber, are preloaded and allowed considerable deflection even with light load so that the coupling can absorb a large amount of torsional vibration as well as shocks and uneven impulses, says the manufacturer. The coupling needs no protection against atmospheric conditions, water, dirt, or grit and no lubrication is required. Pressed steel covers are furnished except on the smallest sizes. Horsepowers (100 rpm) range from 0.15 to 13.80; a recently issued bulletin contains detailed description of construction, data, and prices.—Morse Chain Co. (Division of Borg-Warner), Ithaca, N. Y.

New Alternating Current Welder

No. 127.—New alternating current welder (known as "Shield Arc AC") is of the motor generator type which takes 2 or 3 phase alternating current of standard voltages and frequencies and converts it into alternating current of lower voltage and at

higher frequency most suitable for arc welding with either heavily coated or washed electrodes in all positions.

The manufacturer claims the following advantages: Improved arc characteristics due to the higher frequency such as more stable arc, less magnetic blow, easier starting of arc; improved weld metal since there is less spatter loss and in multiple pass

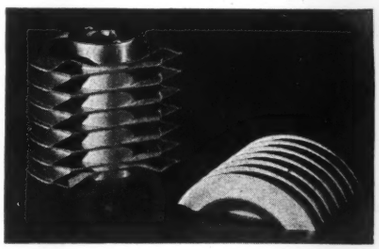


welding greater density; better power characteristics from the line, since the machine takes power from all phases, unbalancing of phases is eliminated and a higher power factor is obtained; regulation of the transmission equipment is materially improved.

The new welder is built in portable and stationary a-c motor driven models in two sizes. The smaller capacity machine can be used for continuous welding with electrodes of 3/32 to 5/16 in. in size; the larger handles electrodes from 1/8 to 3/8 in. in size. These machines are wired for 220, 440 or 550 volts, a-c supply, 2 or 3 phase, 50 and 60 cycles.—The Lincoln Electric Company, Cleveland, Ohio.

Reinforced Sheave for V-Belts

No. 128.—New reinforced steel sheave (Duro-Brace Texsteel) introduced. The outside walls of sheaves sometimes bend under the strain of excessive overloads, with the result that they are thrown off true. The outside walls of these sheaves are rein-



forced by a convex steel plate to strengthen vulnerable areas to eliminate distortion, irrespective of the strains to which they are subjected.

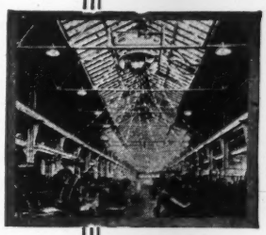
Welding at the rim and web, for additional strength, and the interior grid-type construction, for rigidity, which were advantageous features of the former design are retained in the new sheave.—Allis-Chalmers Mfg. Co. (Texrope Div.), Milwaukee, Wis.

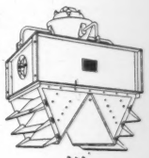
New Globe and Angle Valves

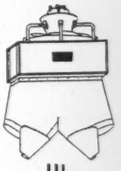
No. 129.—New line of renewable bronze angle and globe valves have radial seat between body and bonnet to insure a tight joint and perfect alignment of all parts to decrease wear. Seat is drawn to a tight joint by union nut without sliding or scraping the surface of seat, said to increase life of valve and assure tight body-joint after every assembly. Disc ring not only serves efficiently in the control of the steam but also on hot and cold water. It is composed of long-fibre asbestos, compounded with vulcanizing elements and given a special cure.

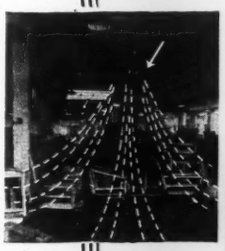
Here's Real Economy and Efficiency in a

UNIT HEATER!









1 Light weight construction (thru scientific design) of the Wing Featherweight Unit Heater permits suspension of unit directly overhead in any desired location.

2 The vertical downward discharge of heated air insures penetration to and uniform diffusion over entire work area.

3 From their overhead location near the ceiling, these heaters take the air from practically the highest point in the room or building, thus preventing wasteful accumulation of heated air at this point. This naturally results in economy of steam.

4 The Wing Featherweight Unit Heater is low in first cost, installation cost, and maintenance cost.

5 The finned tubes can be individually removed and replaced in case of accidental damage.

6 Being perfectly flat and free from crimping the fins offer minimum resistance to air flow, and do not catch and hold dirt—the accumulation of which will greatly reduce the efficiency of any heater.

7 The scientifically designed Wing Scruplex Propeller Fan is used in this heater. It is noted for its ability to deliver a large volume of air, from great heights at high velocities, and against high static pressures.

8 Each completed heater is given a 150 lb. steam test, and subjected to 1,000 lbs. hydrostatic pressure.

9 Fifty-six years of specialized air handling experience insures a thoroughly satisfactory installation.

10 It will pay you to write for Bulletin H-5—it gives the very latest data on heating problems.

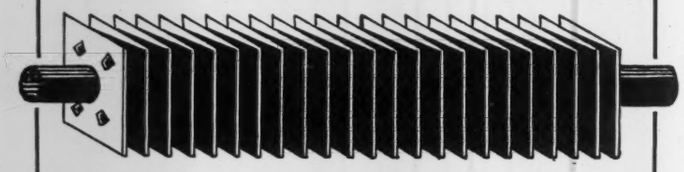
L. J. WING MFG. CO.
14th St. & 7th Ave., New York, N.Y.

Specialists in Air Handling Equipment Since 1878.

WING *featherweight* UNIT HEATERS
"Floodlights of Heat"

Individual Finned Tubing

in 32 Combinations of Fin and Tube Size and Fin Spacing



For Every Refrigeration or Air Conditioning Application.

Bush has supplied Fin Coils with surface ranging from 60 to 6,000 sq. ft. for air conditioning and product cooling.

ALUMINUM, COPPER OR STEEL

THE BUSH MFG. CO.
HARTFORD, CONN.

YOUR COPY IS READY!

LATEST INFORMATION ON FORCED CIRCULATION HOT WATER HEATING SYSTEMS

Bell and Gossett's new loose-leaf catalog brings you latest engineering achievements in low-cost domestic water heating and automatic hot water circulation controls

The most complete source of information of its kind ever published! 50 pages of installation diagrams, water heater capacity charts, piping layouts and fully detailed information on the new Bell & Gossett line of Indirect Water Heating Systems, Booster Pumps, Flow Controls and allied Heating Specialties. Every Heating Contractor on the alert for equipment which can be easily sold on a money-saving basis should have a copy of the new B & G Catalog.

SEND THIS COUPON TODAY

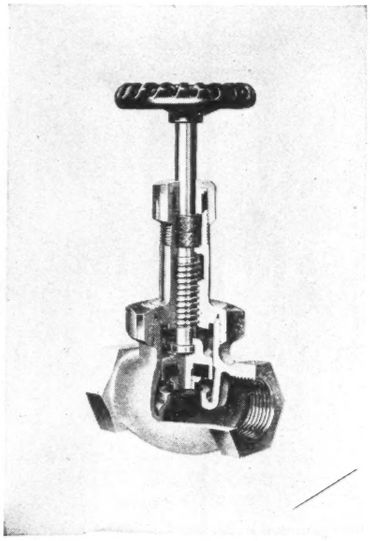
Bell & Gossett Co., Dept. C, 3000 Wallace St., Chicago.
Send at once your new 50-page Catalog.

Name.....

Address.....

Disc holder is of standard dimensions, permitting the use of other standard makes of disc rings if desired.

Stem is of rolled red bronze, averaging 65,000 lb tensile strength. At least five threads are at all times in contact with the bonnet. Union nut is of heavy bronze with large hexes for

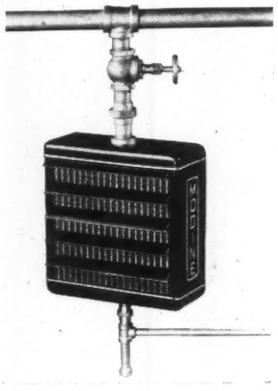


a firm wrench grip. Protected top seat about the threads on stem gives greater assurance of a clean, tight joint when the valve is fully opened for the purpose of repacking the valve under pressure, states the maker.

The ventilated, malleable iron handwheel assures a firm, cool grip.—The Fairbanks Company, New York City.

Unit Heater Line Improved

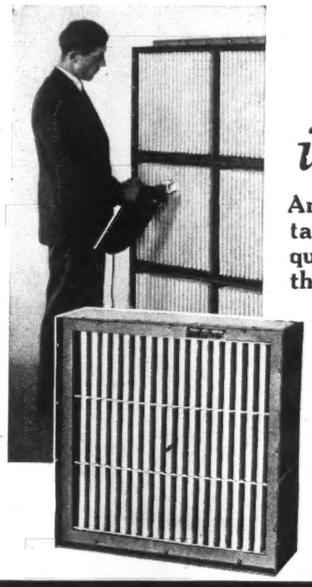
No. 130.—Improved line of suspended, propeller fan, unit heaters is made in sixteen steam and fourteen hot water sizes, ranging from the equivalent of 76 sq ft of radiation to the equivalent of 2,015 sq ft of radiation. New features incorporated in these units are the result of a special study, and include sturdier construction of the condenser, and incorporation of an expansion bend principle for each condenser tube to allow for individual and differential expansion of each tube. Condenser is entirely of copper or copper alloys, the tubes being red brass, fins (metallically bonded by a new process) of copper, top



and bottom tanks of iron pipe size copper, and inlet and outlet solid bronze castings. Housings are of sheet steel.

The units are equipped with "velocity generators," aimed to collect the air as it leaves the fan and so sectionalize and direct it that it will be distributed equally over the entire condenser area and insure air leaving the unit at proper direction and velocity. Re-adjustable, horizontal deflectors of streamline design are attached to the face of the heater.

An Air Filter Should be Measured Not by What It Stops



But by What it Passes!

Any air filter stops a certain amount of dirt. The question is—how clean is the air it passes?

With the ANNIS AIR FILTER you get the highest possible efficiency — 99.9% plus (by test).

"Lowest Cost Plus Highest Efficiency"

GET THE FACTS—WRITE FOR BULLETIN F-320.

COPPUS ENGINEERING CORPORATION

374 PARK AVE. WORCESTER, MASS.

ANNIS AIR FILTERING EQUIPMENT

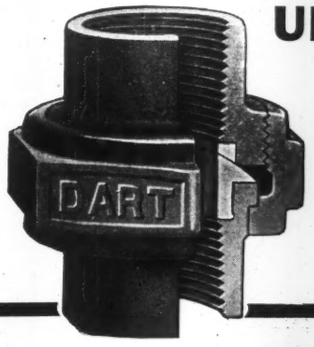
PERSONAL

The heating specialist whose profit on radiator air and vacuum valves has been merely moderate, can learn something to his advantage by stocking and selling Dole Valves. Five profit points on this complete line of air and vacuum valves lead the way to more valves per order, and more margin per sale. Advertising in the special fields where better volume can be expected has intensified consumer acceptance. A fine record of past performance and precision under all conditions has built a prestige of definite sales value. Write for the five points of Dole Profit.

THE DOLE VALVE COMPANY
1901-1933 Carroll Avenue
Chicago, Illinois

Manufacturers of Dole Air and Vacuum Valves for one-pipe steam systems.

DART UNIONS



TROUBLE-FREE

The Dart Union makes the vulnerable part of a pipeline strong and troublefree. The bronze-to-bronze seats cannot corrode. You can expect long and satisfactory service when Dart Unions are used.

E. M. DART MFG. CO.
PROVIDENCE, R. I.

Sales Agents:
THE FAIRBANKS CO.
NEW YORK & BRANCHES

Canadian Factory:
DART UNION CO. Ltd.
TORONTO, CANADA

SPECIFY DART

CHROMALOX

This 60-Page book of Electric Heating Facts-FREE

—reduce week-end heating costs
—Ideal for hard-to-heat places!

If your plant is closed Saturdays—if only the offices or a few departments operate—consider the economy of banking boiler fires and using Chromalox Unit Heaters. Pay for heat only *when* and *where* you need it. More and more industrial plants are finding it worthwhile.

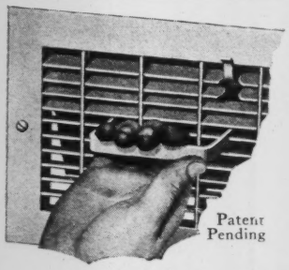
Or for heating isolated buildings, rooms and other remote places—Chromalox Unit Heaters provide a quick, economical, permanent answer. No big installation costs, no delay, no heat losses—you can put them to work *quickly* anywhere a wire line can go. Capacities 1½ Kw. to 40 Kw. —all voltages.

Get the facts—use the coupon below—mail it with your letterhead.

• • • • • • • • • •

EDWIN L. WIEGAND CO.,
7610 Thomas Blvd., Pittsburgh, Pa.

Send me the new 60-page CHROMALOX book.
I wish to heat.....
Name .....
Position .....

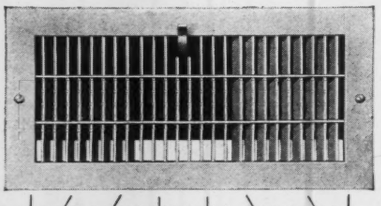


You Can Direct Air Flows with Certainty

with INDEPENDENT "Fabrikated" *Adjustable* Directed Air Flow REGISTERS and GRILLES

Grille bars may be adjusted—before or after installing—to direct air flow to any angle to 45 degrees. The greatest development ever made in forced air registers. Send for catalog, including engineering data.

Independent Register & Mfg. Co.
3757 E. 93rd St.
Cleveland, Ohio



G&O FINNED TUBING Quality Service

We are splendidly equipped to supply high efficiency finned tubing in a wide range of sizes for all heat transfer purposes.

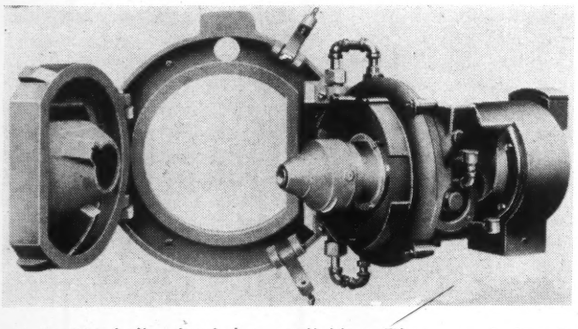
CORRESPONDENCE INVITED

THE G&O MANUFACTURING CO.
142 Winchester Avenue - New Haven, Conn.
Established 1915
Manufacturers of "G & O" Automotive Radiators

Other features include direct suspension of the unit from the piping, and 360 deg rotatability of the unit. A new 32 page booklet on heating with unit heaters discusses this method of heating in detail, describes the units, and presents complete application and capacity data, including industrial space heating, drying, special applications, control, etc.—Modine Manufacturing Company, 1750 Racine St., Racine, Wis.

New Line of Industrial Oil Burners

No. 131. A new line of industrial oil burners has been developed to meet the varied demands of commercial and industrial requirements, ten standard sizes ranging from 7 boiler horse-



power to 300 boiler hp being available. They are designed to burn No. 5 or No. 6 fuel oil. The burners are furnished fully automatic using gas-electric ignition or an expanding gas pilot, with or without built-in pump; they can also be furnished for manual operation.

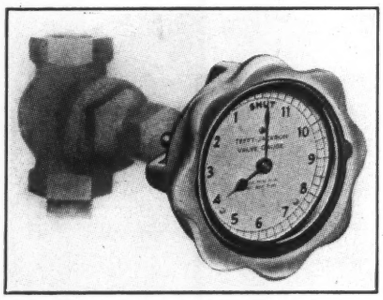
The atomizing cup is driven at a constant speed of 3450 rpm. The a-c motor burner has one main shaft to carry the rotor, pump worm drive, fan and atomizing cup; the main shaft of the d-c burner is indirect driven.

Special features include the feeding of oil through the cup through a radial and axial hole in front of the shaft, said to combine the advantages and eliminate the disadvantages of other types of feed and to break up the oil to assist atomization; cooling of the motor housing by the primary air which also heats the primary air; electric safety lock on the automatic burner which prevents operation when burner is in open position; dynamic balancing of rotary parts; and machining for interchangeability of parts.

The illustration shows the tile lined door of one model with the burner attached.—Gilbert & Barker Mfg. Co., Springfield, Mass.

Indicator Shows Valve Position

No. 132. A valve position indicator which tells at a glance whether a valve is shut or how many turns open or what proportion thereof, operates by a positive gravity mechanism making it applicable to valves whose stems are in a horizontal or semi-horizontal position. The maker states the indicator is ideal for



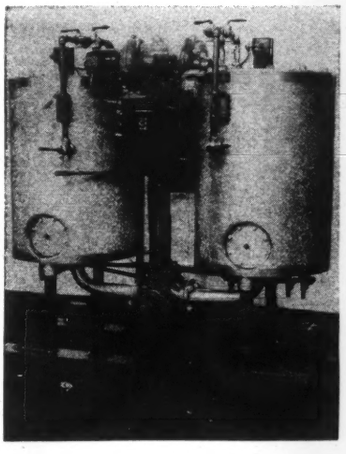
manual control work as the same setting will give the same result each time the valve is operated. The indicator is adjustable in its own bracket which replaces the regular valve wheel, enabling resetting when the valve wears or when new seat and disc are installed.

When the large and small hands of the indicator are at "shut" the valve is closed; when small hand is at "one" and large hand at "shut" the valve is one turn open, and so forth.

A number of sizes are available and special attachment may be had for large valves, rising stem valves, and overhead chain operated valves.—Tefft-Jackson, Inc., 120 Main St., Pawtucket, R. I.

Unit for Low Humidities

No. 133. The "Lectrodryer" is a unit especially applicable to the conditioning of special process rooms, laboratories, and the like where dewpoints lower than normal are desired. The unit shown here was recently built to maintain 5 per cent relative humidity in a laboratory; it draws air from the room, dries it, and returns it to the room so that the mixture will give the low humidity required. In some cases it is desirable to obtain



low temperatures in addition to low humidities; to do this, the air may be dehumidified with this apparatus and then cooled by refrigerating equipment.

This drying unit uses activated alumina as the adsorbent. Units are built for operation at approximately atmospheric pressure; they are also built for operation at pressures from 90 to 125 lb per sq in., and may be had for higher pressures. Standard sizes in single and multiple units are available; the smallest laboratory size has a capacity of 100 cu ft per hr, is reactivated by plugging into a 110 volt light socket.—Pittsburgh Lectrodryer Corporation, P. O. Box 1008, Pittsburgh, Pa.

New Line of Condensation Units

No. 134.—Line of centrifugal, motor driven condensation units (known as "Redi-Return") suitable for handling water at 210 F designed to meet demand for improved performance at lower price. Available in several capacities for handling from 5,000 to 100,000 sq ft radiation, maximum discharge pressures from 10 to 100 lbs per sq in., in single units (with one pump and motor and one float switch connected to receiver) and twin units (two pumps, two motors, and two float switches connected to the receiver). Twin unit has advantage of a spare if repairs or adjustments are necessary, and affords increased capacity for peak loads.

Pumps are bronze fitted with bronze impellers of enclosed type. Motor is of standard manufacture with specially machined end bell. Receivers are of steel, welded construction. Automatic operation accomplished by means of float and float switch.

New bulletin gives detailed description and includes capacity table with selection data.—American Steam Pump Company, Battle Creek, Mich.

STRONG TRAPS

For All Drainage Requirements

Upright and Inverted Bucket types for low, medium and high pressures up to 1800 pounds.

Guaranteed for One Year

Ask for Bulletin No. 61-H

The Strong 80 Series Trap

THE STRONG, CARLISLE & HAMMOND CO.
1392 WEST THIRD ST. -I- CLEVELAND, OHIO

Vilter

REFRIGERATION
—DOES A REAL JOB—
ALWAYS ●

We build a complete line of compressors. Vertical, Horizontal and Rotary. We also build a complete line of shell and tube equipment, pipe work, valves and fittings as well as unit type air conditioners. Literature on request, of course.

THE VILTER MANUFACTURING CO.
Established 1867
2124 S. FIRST ST. MILWAUKEE, WIS.

WYCKOFF CALIFORNIA REDWOOD PIPE
For water or acidulous liquids
Does not scale, pit or corrode

Greater Capacity, Lower Friction Loss. Immune to Electrolysis.

Sizes, 1" up—Pressures up to 172 lbs.

WYCKOFF STEAM PIPE COVERING

Perfect insulation for underground steam or hot water lines and frost protection for exposed lines.

A. WYCKOFF & SON CO., Elmira, N.Y.

Detroit Stokers

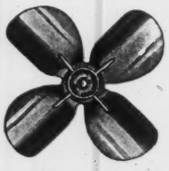
DETROIT STOKER COMPANY
GENERAL MOTORS BUILDING
DETROIT, MICH.

FOR LOWER STEAM COSTS
FOR ALL OPERATING CONDITIONS
FOR ALL BOILERS
FOR ALL BITUMINOUS COALS

TORRINGTON
FANS AND BLOWER WHEELS

Patented All Aluminum Multiblade, Balanced Blower Wheels. Unexcelled for quiet and smooth operation.

30 years' experience building Propeller Fans, assembled, balanced and tested, ready to mount on motor shaft.



THE TORRINGTON MFG. CO
44 FRANKLIN ST.
TORRINGTON, CONN.

CAST IRON CONDUIT

The completely engineered Conduit System ● Furnished either in tile or cast iron ● All parts interlock ● Delivers 90% + efficiency ● Waterproof Asbestos Dry-paC insulation ● Typical layouts on request.

THE RIC-WIL CO. • 1562 Union Trust Bldg., Cleveland, Ohio
Branches: New York San Francisco Chicago • AGENTS IN PRINCIPAL CITIES

REG. U. S. PAT. OFF.
RIC-WIL
CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

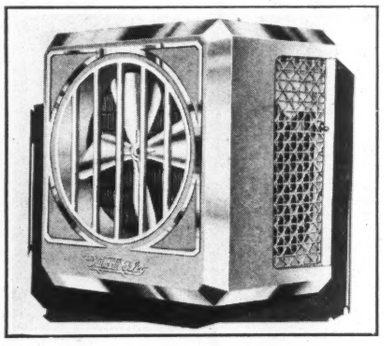
ARMSTRONG TRAPS (Original Inverted Bucket Type)
For any capacity and for any use
Catalog on Request
ARMSTRONG MACHINE WORKS
874 Maple Street
Three Rivers, Mich.
Stocks in all Principal Cities

BAKER
specializes in All Types of
REFRIGERATION & AIR CONDITIONING

Descriptive folders free on request—write today.
BAKER ICE MACHINE CO., Inc., 1590 Evans St., OMAHA, NEB.

Unit Cools and Dehumidifies

No. 135. The unit illustrated for cooling and dehumidifying is designed for wall mounting, is 12 in. wide, 9 in. deep, and 13 in. in height. It has, states the manufacturer, a capacity of 3000



Btu per hr, and is equipped with an 8 in. fan and a 1/100 hp motor. The finish is cast aluminum, satin and polished. It requires a ½ hp condensing unit.

These units are designed to lower the temperature slightly, reduce humidity, and circulate air to promote comfort; they are also used for product cooling. Sulphur dioxide, methyl chloride, and freon are the refrigerants used.—The Humidi-Cooler Corporation, West Haven, Conn.

Recent Trade Literature

For your convenience in obtaining copies of bulletins, see coupon on next page

No. 227. Belting: Chicago Belting Company, 113 N. Green St., Chicago, Ill. Data sheet on horizontal, vertical, and ceiling type flat leather belt, short center drives for operating continuously without slip.

No. 228. Boulder Dam: Ingersoll-Rand Company, 11 Broadway, New York City. 48 page booklet "The Story of the Boulder Dam" (Part 4) containing detailed descriptions of this project, including the method of pouring the concrete and how the concrete is cooled by refrigeration.

No. 229. Cable: General Electric Company, Schenectady, N. Y. 128 page book describing and listing all standard types of insulated wire and cable for transmission, distribution and control. Dos not include paper insulated types of cable, used principally for transmission of large blocks of power at higher voltages, but covers varnished-cambric insulated; glyptal-cloth insulated; rubber insulated; asbestos types; shipboard cables; magnet wire and coils. It is a companion to the 80 page book "How to Select Insulated Cable."

No. 230. Fans: Propellaire, Inc., Springfield, O. Illustrated folder "To Keep Production Moving. . . . Keep Air Moving" devoted to applications of airplane propeller type fans for industrial ventilation and exhaust, a number of installations being shown and described. A special type of construction applies "streamlining" to the air flow.

No. 231. Heating: National Radiator Corporation, Johnstown. Pa. Pocket size "Fitters Guide" presenting an easy method of figuring radiation for steam, vapor and hot water heating systems, revised to conform with heat transmission coefficients in 1934 *A. S. H. V. E. Guide.*

No. 232. Heating: Gorton Heating Corp.. Cranford, N. J. Four page bulletin describing equalizing system designed to equalize steam and vapor heating systems so radiators will heat up evenly and quickly.

No. 233. Metering: The Bristol Company. Waterbury, Conn. Eight page bulletin describing the "Metameter" for telemetering (long distance metering) pressure, liquid level, temperature, flow and motion—recording, controlling, indicating. Equipment consists of transmitter electrical circuit (simple two wire circuit), and receiver; durations—and not intensities—of the transmitted impulses are proportional to the values measured. The bulletin describes the features, explains the principle of operation, shows and describes typical applications (such as showing at central heating plant temperatures in buildings supplied with steam, etc.).

No. 234. Photo-Electric Cells: Continental Electric Co., St. Charles, Ill. Six page bulletin describing photo-electric cells and their various application.

No. 235. Refrigeration: Frick Company, Waynesboro, Pa. Bulletin announcing refrigerating machine oil and discussing the lubrication of refrigeration compressors. Also data sheet on milk cooling cabinets and refrigerating units.

No. 236. Registers and Grilles: Independent Register & Mfg. Co., 3757 E. 93rd St., Cleveland, Ohio. 32 page catalog of registers and grilles for forced air giving complete information about construction, features, applications, tables of capacities, finishes, etc.

No. 237. Sheet Iron: Republic Steel Corporation (Central Alloy Division), Massillon, Ohio. 64 page booklet "Sheet Iron —A Primer" (fifth edition) explaining in non-technical language the step by step story of modern manufacture of sheet iron, tracing production from ore mine to final inspection of sheets. Gauge tables and a glossary of metallurgical terms supplement the interesting story.

No. 238. Temperature Control: Minneapolis-Honeywell Regulator Company, 2701 Fourth Ave. South, Minneapolis, Minn. 20 page booklet entitled "Heat Acceleration," explaining what it is and how it differs from heat *anticipation.* History of development of temperature control devices is discussed briefly and the principle of employing artificial heat is explained clearly and in interesting manner. The advantages of the acceleration principle in smoother control of automatic heating plants are described and diagrammed.

No. 239. Valves: The Edward Valve & Mfg. Co., East Chicago, Ind. Four page pamphlet (November, 1934, issue of "Valve Values") discussing forged strainers, the reconditioning of valves, an extensometer test, and blowoff valves.

No. 240. Welding: The Linde Air Products Company, 30 E. 42nd St., New York City. 24 page booklet etntitled "Precautions and Safe Practices" (revised edition) containing recommendations for the storage, care and handling of oxy-acetylene welding and cutting equipment—a booklet for study and reference.

FOR YOUR CONVENIENCE

Heating, Piping and Air Conditioning,
6 N. Michigan Ave.,
Chicago, Ill.

Send me more information about the equipment mentioned under the following reference numbers in "Interesting Equipment Developments" and "Recent Trade Literature." (Check numbers you are interested in):

124	125	126	127	128	129	130	131
132	133	134	135	227	228	229	230
231	232	233	234	235	236	237	238
239	240						

Name..... Title.....

Company .....

Address .....

CLASSIFIED ADVERTISING

8 cents for each word including heading and address. Count nine words for keyed address. Minimum $2.00 for each insertion. One inch $4.00. Cash must accompany order. Copy must be in our hands by the twenty-fifth of the month previous to issue.

REPRESENTATIVES

RADIATOR SALES OPPORTUnity—strong established manufacturer. Outstanding new advanced type heating radiator. High grade experienced sales representatives who can operate upon straight commission basis should write for complete particulars. State qualifications fully. Address Post Office Box 1222, Pittsburgh, Pennsylvania.

Manufacturers Attention

A Company, well organized, desires to represent manufacturers of quality unit heaters, fans, blowers, air conditioning equipment, and accessories, on an exclusive commission basis in the metropolitan New York area. Favorable contacts with architects, contractors, and industrials supported by a staff experienced in sales engineering. We can build and maintain a profitable territory for reputable manufacturers. Please answer with details. All replies confidential. Address Key 241-A, "Heating, Piping & Air Conditioning," 6 No. Michigan Ave., Chicago, Ill.

Use This Page
To Get
What You Want

If you are looking for competent employes; or if you contemplate a change in position; have a patent for sale; second-hand machinery or tools; form a co-partnership, etc., your advertisement on this page will put you in touch with the people you desire to reach.

The cost of insertion is only eight cents a word and may mean many dollars to you.

FOR SALE

? ? ? ? ? ?
HAVE YOU A SHEET METAL PROBLEM: FORMING—BENDING—PUNCHING—SHEARING
WE HAVE A MACHINE FOR EACH OPERATION ON SHEET METAL
Your Inquiries Earnestly Solicited
WARD MACHINERY CO.
SPECIALISTS
MACHINES — TOOLS — SUPPLIES FOR SHEET METALS
562 W. Washington Boulevard
CHICAGO, ILLINOIS

MISCELLANEOUS

SEAMLESS COPPER FLOATS

Naugatuck Mfg. Co., Union City, Conn.

Index to Advertisers

Firms represented in this issue are identified by the folio of the page on which their advertising appears. Advertising which appears in alternate issues is marked with an asterisk.

Aerofin Corp. 79
Air Reduction Sales Co. ..... Inside Back Cover
Allis-Chalmers Mfg. Co. 5
American Air Filter Co., Inc. 14
American Brass Co. 7
American District Steam Co.* .....
American Steam Pump Co.* .....
Armstrong Machine Works 86

Baker Ice Machine Co., Inc. 86
Bell & Gossett Co. 82
Binks Manufacturing Co. 78
Bristol Company, The* .....
Buffalo Forge Co. 18
Burnham Boiler Corp. 90
Bush Manufacturing Co., The 82
Byers Co., A. M. 3

Carey Company, The Philip* .....
Century Electric Co.* .....
Clarage Fan Co. 77
Coppus Engineering Corp. 83
Crane Co. ..... Back Cover

Dart Mfg. Co., E. M. 83
Dayton Rubber Mfg. Co., The* .....
Delco Products Corp. 15
Detroit Lubricator Co.* .....
Detroit Stoker Co. 85
Dole Valve Company, The 83

Emerson Electric Mfg. Co. 22
Fairbanks Co., The 21
Fedders Mfg. Co. 75
Fretz-Moon Tube Co., Inc. 74
Frick Company 76

G & O Mfg. Co., The 84
General Electric Co. ... Inside Front Cover
General Insulating & Mfg. Co.* .....
Geuder, Paeschke & Frey Co.* .....

Hoffman Specialty Co., Inc. 13
Independent Register & Mfg. Co. 84
Inland Steel Co. 20

Johnson Service Co.* .....
Jones & Laughlin Steel Corp.* .....

Lincoln Electric Co., The 89
Linde Air Products Co., The 4

Mears-Kane-Ofeldt, Inc. 80
Minneapolis-Honeywell Regulator Co. 80
Modine Manufacturing Company 17
Mueller Brass Co. 6

Nash Engineering Co. 26
National Tube Co.* .....
Nelson Corp., The Herman* .....

Owens-Illinois Glass Co.* .....
Oxweld Acetylene Co. 4

Pittsburgh Piping & Equipment Co.*
Prest-O-Lite Company, Inc., The 4

Republic Steel Corp. 24
Revere Copper and Brass, Incorporated 16
Ric-Wil Co., The 86

Sarco Co., Inc. 19
Staynew Filter Corp.* .....
Streamline Pipe & Fittings Co. 6
Strong, Carlisle & Hammond Co. 85
Sturtevant Co., B. F. 73

Taylor Forge & Pipe Works* .....
Torrington Mfg. Co., The 86
Trane Company, The 79
Tube-Turns, Inc. 12

Union Carbide and Carbon Corp. 4
Union Carbide Sales Co. 4

Vilter Manufacturing Co., The 85

Wagner Electric Corp.* .....
Walworth Company 9
Wiegand Co., Edwin L. 83
Wing Mfg. Co., L. J. 81
Worthington Pump & Machinery Corp.* .....
Wyckoff & Sons Co., A. 85

Youngstown Sheet & Tube Co., The .. 8

in Boston-East Boston Vehicular Tube

Again, where human lives are at stake, "Linc-Weld" motors are placed on the job. The two latest underwater vehicular tunnels to be completed—first the Geo. A. Posey tube between Oakland and Alameda, Calif., and now the world's largest, the Boston-East Boston tube—depend on "Linc-Weld" motors to keep the air fresh and remove all danger of asphyxiation. Twenty-eight "Linc-Weld" two-speed squirrel cage type motors drive the fans and blowers which handle as high as two million cubic feet of air per minute, changing all the air in this newest tube 40 times every hour.

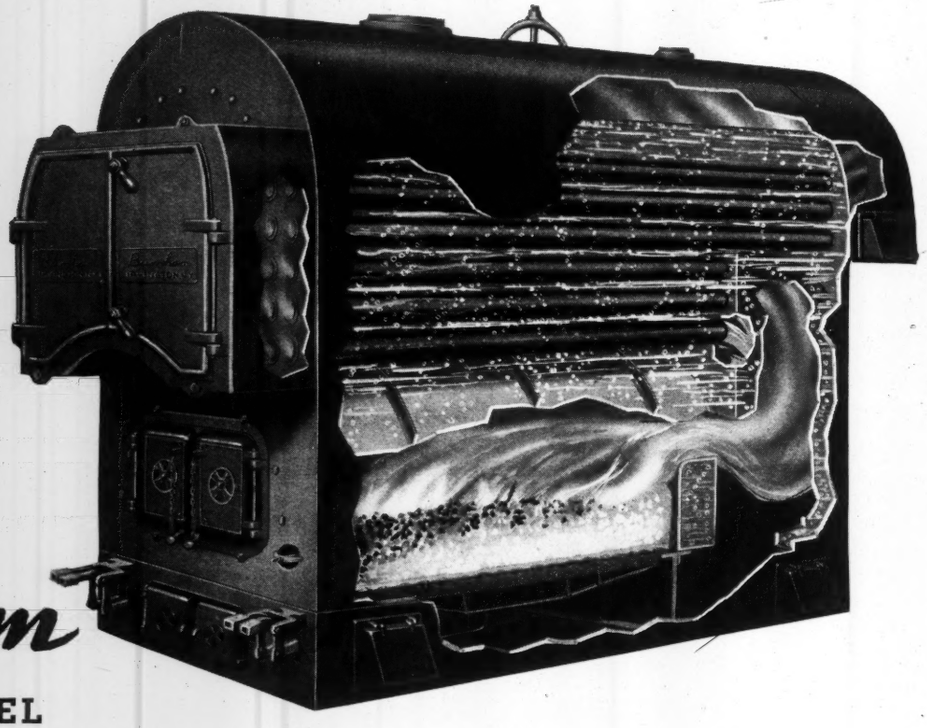
To meet specification demands for extra high efficiency and power factor required only Lincoln's usual standards of design, materials and construction as applied to all types of "Linc-Weld" motors. Thus you, too, can obtain dependability plus improved operating characteristics of "Linc-Weld" motors for your equipment.

LINCOLN

THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO

Manufacturers of "Linc-Weld" Motors and "Shield-Arc" Welders

M-14



Burnham

WELDED-STEEL

BOILERS for All Purposes

The increasing demand for steel boilers for residential and other work is based on their economy and their portability. The steel base is easily and speedily set up in the basement and the boiler itself is then easily placed on the base without any further assembling. Large furnace and combustion chamber provides the room necessary for efficient combustion.

These low-pressure boilers will

1—burn anthracite
2—burn cheaper grades of hard coal
3—burn soft coal smokelessly
4—burn oil

With fuel oil, can be fitted for incineration, also. With any heating system can be equipped for hot water supply.

Built strictly in accordance with A.S.M.E. Code.

Have the fuel-saving qualities true of all Burnham's because of long fire-travel.

For any low-pressure job it guarantees low operating costs.

A three-purpose boiler, but adaptable to four different requirements.

1—Three-purpose type, for straight heating, for hot water supply, and for garbage burning. Has two independent grates and fire boxes. Equipped with U-tube Taco Water Heater.

2—Two-purpose type—for heating and for water supply. Has built-in water-filled bridge wall. See illustration above.

3—For oil or gas, either with or without garbage burner.

4—Smokeless, for burning high volatile soft coal.

Burnham has been making steel boilers for over 27 years and cast iron ones for close to three-quarters of a century. Glad to send you our out-of-the-usual catalog.

Burnham Boiler Corporation

IRVINGTON, NEW YORK

Representatives in All Principal Cities of the United States and Canada